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A star (*) indicates that the Abstract deals with Apparatus and Instruments.

JANUARY, 1935.

GENERAL PHYSICS.

ADSORPTION.

1. Adsorption of Alkali Metals on Metal Surfaces. Parts II and III. J. H. de Boer and C. F. Veenemans. *Physica*, 1. pp. 953-965, Oct.-Nov., 1934. *In English*.—Continuing previous work [see Abstract 3966 (1934)], the adsorption of Cs^+ ions on a tungsten surface, together with the electrical images thus formed, is shown to give rise to a dipole moment which reduces the work function of the surface. The theoretical and experimental results are in good agreement; Langmuir's views on the subject are disputed. The heat of vaporisation of the atoms, the adsorption isotherm and an expression for the electron emission are obtained on the electrical image theory. If a few positive ions are already attached to the surface, the negative image field evoked causes succeeding ions (up to a certain limit) to be still more strongly attracted. This increase in binding energy is shown experimentally for Cs ions: also, the effect on the electron emission formula is calculated. F. C. C.

2. Clean-Up of Gases by Magnesium, Calcium and Barium. A. L. Reimann. *Phil. Mag.* 18. pp. 1117-1132, Dec., 1934.—The contact gettering powers of Mg, Ca, Ba black (by heating BaN_6 at 400°), Ba bright (by further heating black Ba till it begins to melt) in regard to some or all of O_2 , N_2 , H_2 , CO and CO_2 have been examined, confirming previous results [see Abstracts 271 (1932) and 4713 (1933)]. The order of activity is Mg, Ca, Ba bright, Ba black. As a rule much more than a monomolecular layer is absorbed before fatigue is shown. The gas is either chemically combined (*e.g.* Ba and H to a hydride, Mg and CO_2 to MgO and CO), or is adsorbed and then diffuses into the metal, a process accelerated by rise in temperature. In addition to causes already noted (the velocity of electrons to remove CO from Mg must be $< 6\text{V.}$) absorbed gas may be displaced by another gas, which combines with the getter (*e.g.* H_2 will displace N from Ba). Electric-discharge gettering of CO by Mg has also been examined. This may be regarded as contact gettering of particles directly or indirectly produced by the discharge, *e.g.* positive ions, metastable molecules, or single atoms, which in some cases combine chemically with the getter. C. A. S.

3. Adsorption of Hydrogen and of Carbon Monoxide on a Surface of Zinc and Molybdenum Oxides. H. S. Taylor and G. Ogden. *Faraday Soc., Trans.* 30. pp. 1178-1190, Dec., 1934.—A mixture of zinc oxide and molybdenum oxide has been shown to exhibit in separate regions of temperature both low-temperature, van der Waals and high-temperature activated adsorption of both H_2 and CO. The heats of adsorption and the activation energies of adsorption have been determined for both gases and for each type of adsorption. The data obtained reveal why incorporation of molybdenum oxide definitely decreases the catalytic activity of zinc oxide in methanol synthesis. AUTHORS.

4. Adsorption of Phosgene by Active Charcoal. H. Engelhard and W. Stiller. *Zeits. f. Elektrochem.* 40. pp. 833-836, Dec., 1934.—Activated charcoal which is partially dehydrated offers a better period of resistance towards phosgene, than a specimen of equal water content which

has been prepared from dry charcoal. The difference corresponds to the vapour pressure differences in the two branches of the water-vapour-pressure isotherms. This behaviour is explained in that the leaving water vapour occupies the inner surface of the charcoal thereby hindering access of phosgene. Hereby is also made clear the initial decrease of resistance on addition of moisture from air at low water contents. H. H. Ho.

See also Abstracts 324, 428.

ATOMIC AND MOLECULAR STRUCTURE.

5. Classification of Atomic Nuclei. V. Cerdynceyev. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 3. pp. 576-583, Sept. 21, 1934. *In French.*—The atomic nuclei are classified into four groups according as the atomic mass and atomic number are respectively of the forms (1) $2n$, $2m$; (2) $2n$, $2m + 1$; (3) $2n + 1$, $2m$; and (4) $2n + 1$, $2m + 1$. Each is then further subdivided, (1), (2) and (3) according as n is of the form (a) $2n'$ or (b) $2n' + 1$; group (4) as it is of the form (a) $4n' + 3$ or $4n' + 2 + 3$. It is considered that the presence of 4 or a multiple thereof, 2, and 3 indicate respectively the presence of formations in the nucleus similar to α -particles, to a deuteron, or to an H_1^3 nucleus. The percentages of the various groups in the earth's crust (indicative of relative stability) are (1a) 71.24, (1b) 2.30, (2a) 0.054, (2b) 1.25×10^{-16} , (3a) 1.19, (3b) 0.003, (4a) 7.86, (4b) 0.11. Other relations are discussed. C. A. S.

6. Evidence of Layers of Neutrons in Nuclei. W. Yeh. *Comptes Rendus*, 199. pp. 1209-1211, Nov. 26, 1934.—If T is the half-life period of the radioactive product of bombardment of an element with neutrons [see Abstract 3975 (1934)], and $10/\log T$ is plotted against P the number of protons in the bombarded element, a curve is obtained showing relations similar to those deduced by Elsasser and Guggenheimer [see Abstracts 3074 and 3970 (1934)], implying the existence of layers of neutrons and protons in the nucleus. C. A. S.

7. Constitution of Elementary Particles and Nuclear Forces. W. M. Elsasser. *Comptes Rendus*, 199. pp. 1213-1215, Nov. 26, 1934.—Intranuclear forces (much greater than internuclear) occur in the region where Maxwell's equations are not valid, i.e. inside the elementary particles constituting the atomic nuclei; consequently the dimensions of their internal structure must be considered, and some model of such particle is necessary. It is suggested that, e.g. an electron is a vortex ring, radius $h/2\pi mc$, within which the charge e circulates with velocity c , producing a magnetic moment of one Bohr magneton, and accounting for the spin, while attraction or repulsion between different particles results according as their spins are parallel or antiparallel. C. A. S.

8. Radioactivity and Nuclear Synthesis. H. J. Walke. *Phil. Mag.* 18. pp. 795-822, Nov., 1934.—The manner of formation of elements in a cooling star is discussed and equations representing possible reactions which could follow bombardment with suitable projectiles are given. It is suggested that a radioactive element is an intermediate stage in the synthesis of each element and reference is made to the occurrence of some of these radioactive elements in laboratory experiments. J. E. R. C.

9. Production of Short Range Particles by α -Particle Bombardment of Xenon and Krypton. H. Pettersson and J. Schintlmeister. *Akad. Wiss. Wien, Ber.* 143. 2a. 7. pp. 385-399, 1934.—Kr and Xe are bombarded by α -particles from Po. The resulting particles are detected

by using an ionisation chamber, valve amplifier, and string electrometer. In order to detect the presence of short range particles in the presence of the scattered α -particles, only those α -particles which had been scattered through angles between 140° and 160° were allowed to enter the ionisation chamber, thus excluding all scattered α -particles having a range < 1 cm. Experiments with Xe and Kr show, however, that a considerable group of particles of range < 1 cm. actually enter the ionisation chamber. Possible origins of such particles are discussed. In view of the observation that their ionising power is comparable with that of α -particles, that they are not emitted by I and Ni, and that their number is proportional to the amount of Xe present, the authors conclude that actual disruption of the rare gas nuclei takes place, with emission of short range particles. J. E. R. C.

10. High-Speed Electrons from Fluorine by Bombardment with Neutrons. I. Kurčatov, G. Ščepkin and A. Wiebe. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 3. pp. 572-575, Sept. 21, 1934. *In English*.—LiF was bombarded for 1 min. with neutrons from Be + Rn, and then after 15 sec., the bombarded material was placed before a Geiger-Müller counter with varying thicknesses of Cu intervening, and the absorption thus determined. Emission of electrons of energy $4-5 \times 10^6$ eV. is indicated. This is in agreement with the transformations: $F^{19} + n^1 \rightarrow N^{16} + He^4$ (the mass of N^{16} being 16.0062 ± 0.002); followed by $N^{16} \rightarrow O^{16} + \beta$ with emission of energy equivalent to $16.0062 \pm 0.002-16.000$, i.e., $4-8 \times 10$ eV. C. A. S.

***11. Atomic Disintegration of Light Elements by H and He Particles.** R. Döpel. *Zeits. f. Physik*, 91. 11-12. pp. 796-809, Oct. 23, 1934.—The paper describes apparatus for producing heavy proton currents and the investigation of the α -particles emitted by Be under bombardment by protons, for accelerating potentials between 80 and 120 kV. The yield of α -particles from Be lies between that of Li and B [see Abstract 2922 (1933)], the maximum range is 6 or 7 mm., corresponding to a maximum energy of 1.1×10^6 eV. Evidence of α -particles of range 1 to 4 cm. (due probably to impurities) and of neutron emission was obtained. It is suggested that ${}_4Be^9$ gives rise to 2 α -particles and a neutron and that the exciting proton does not combine with the Be nucleus. The half-value periods of Li, Be and B nuclei, excited by protons are found experimentally to be less than 0.1 sec. and this result is discussed. Further experiments show that the disintegration of Li, Be and B by (100 kV) He particles is highly improbable. W. E. P.

12. Disintegration of Beryllium by γ -Rays. W. Gentner. *Comptes Rendus*, 199. pp. 1211-1213, Nov. 26, 1934.—The numbers of neutrons emitted by Be when bombarded by Ra and by MsTh were counted with varying thicknesses of Pb or Al between the source and Be. Results show that γ -rays of energy 0.9×10^6 eV (from Ra) were most effective in producing neutrons, those from MsTh being less so in the ratio 4.1:1.0 owing to their less suitable energy. The ionisation potential for extracting a neutron from Be is accordingly 0.45×10^6 eV. (Bethe and Peierls, *Internat. Conf. Phys.*, 1934), which therefore is the binding energy of the Be nucleus, assumed to consist of $2\alpha + n$, giving it a mass of 9.013 (n being assumed = 1.0090 ± 0.0005) [see Abstract 4371 (1934)]. C. A. S.

13. Photographic Detection of H-Rays. Marietta Blau and Hertha Wambacher. *Akad. Wiss. Wien, Ber.* 143. 2a. 5-6. pp. 285-301, 1934.—Earlier work has shown that the long lines of points corresponding

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to protons of higher velocities can only be recorded on plates previously treated with pinakryptol yellow [see Abstract 2333 (1933)], and then only if worked in a vacuum or nitrogen. In order to examine the process of photographic detection of H-particles the present authors, using pinakryptol yellow treated plates, first examined the relationship between the grain thickness in H tracks and the ionisation power of the radiation, showing that a grain thickness corresponding to a range of 2 cm. for H-particles has the same effect as it does for α -particles, for which grain thickness is independent of the range. An examination of the reproducibility of the longer lines of points gave satisfactory results, not only regarding the total number of registered lines of points but also regarding their longitudinal distribution. The action of a number of inorganic and organic solutions as sensitisers for the detection of high velocity H-particles upon examination showed that this power was possessed by pinakryptol yellow or similar dyes. The dye does not act as a bromide acceptor nor does its action bear any relation to its desensitisation power for light, but, owing to the adsorption of the dye, the nature of the outer surface of the silver bromide grain is changed. Finally, it is concluded that the desensitisation power of a dye depends on the solvent and on the oxygen content of the place of examination, the dye apparently acting as a catalyst producing an oxidising reaction between the photo-chemically produced silver and the oxygen of the air. [See also Abstracts 531 (1931), 832 (1932) and 1859 (1933)].

R. C. F.

14. Disintegration of the Aluminium Nucleus. Marietta Blau and Hertha Wambacher. *Akad. Wiss. Wien, Ber.* 143. 2a. 7. pp. 401-410, 1934.—Describes the results of experiments, obtained using a photographic method previously described, on the disintegration of the Al nucleus. [See Abstract 1768 (1934) and preceding Abstract]. The groups of protons found by Chadwick and Constable [see Abstract 2889 (1932)] are confirmed by these experiments, and there are indications of an additional group in the region between 35 and 50 cm. The appearance of the individual groups is dependent on the energy of the effective α -particles, the resonance levels being, however, rather indecisive.

R. C. F.

***15. Separation of Isotopes by Diffusion in a Current of Mercury Vapour.** G. Hertz. *Zeits. f. Physik*, 91. 11-12. pp. 810-815, Oct. 23, 1934.—Previous methods for the separation of isotopes [see Abstract 2676 (1933)] are improved upon by the employment of diffusion into a stream of Hg vapour instead of through a porous wall. A particular type of diffusion pump is used which has the property of pumping away the more rapidly diffusing component of a gas mixture. An assembly of twelve such pumps is capable of changing the mixing ratio of the Ne isotopes by a factor of ten.

J. E. K.

16. Isotopic Regularities. A. Carrelli. *N. Cimento*, 11. pp. 542-546, Aug.-Sept.-Oct., 1934.—Various isotopic regularities are exhibited in two graphs (1) of atomic mass A against neutron number $A - Z$ (where Z is the atomic number) and (2) of A against the neutron excess $A - 2Z$. On (2) a step-like curve results if a line is drawn connecting the nuclei of most frequent occurrence, that is those of $A = 4N$, when N is a whole number. The most stable isotopes are shown to be those for which the neutron excess is greatest.

F. C. C.

17. Neutron Emission from Al and Be. R. Jaeckel. *Zeits. f. Physik*, 91. 7-8. pp. 493-510, Oct. 12, 1934.—An expansion chamber is used to determine the energy distribution of the neutrons emitted by bombarding

Al and Be with α -particles from RaEm, RaA and RaC'. The efficiency of neutron production is given as 1.3×10^{-6} per α -particle for Al and 9×10^{-6} for Be. An incidental investigation of the neutron-proton collision shows spherical symmetry in the velocity range investigated.

J. E. R. C.

18. Maximum Kinetic Energy of Neutrons Emitted by the Bombardment of Be by α -Rays from Polonium. L. Winand. *J. de Physique et le Radium*, 5. pp. 597-600, Dec., 1934.—Using a proportional ionisation counter and a Dubois oscillograph, the kinetic energy of neutrons emitted by the bombardment of Be by α -rays from Po is determined from measurement of the secondary ionisation produced by recoiling O and N atoms. The curve of the number of neutrons against energy shows the existence of at least two maxima corresponding to neutrons of 4.5×10^6 eV. and 8.4×10^6 eV., the former being the more intense.

F. C. C.

19. Atomic Nuclei and the Periodic System. Lise Meitner. *Naturwiss.* 22. pp. 733-739, Nov. 2, 1934.—The author reviews recent work upon nuclear disruption and construction with reference to its bearing upon the periodic table.

J. E. R. C.

20. Even and Odd Coordination Numbers. R. C. Menzies. *Chem. Soc., J.* pp. 1755-1758, Nov., 1934.—It has been shown that the stability of a number of newer compounds of the heavier metals depends, not only on the tendency for the central atom to attain a rare-gas structure, but also on the preference for even rather than for odd covalencies. The fulfilment of the latter condition alone indicated that lead diacetylacetone should be capable of existence, and this has been confirmed by its preparation. Sidgwick's statement that the relation of an odd value to the next higher even value is that of unsaturation and Bassett's explanation of the structure of a number of complex Li compounds as determined by the need for Li to become either 2- or 4- coordinated are both indications that this tendency towards even covalencies is displayed all through the periodic classification.

H. H. Ho.

21. Mathematical Analysis of the Single and Double Six-Ring. P. C. Henriquez. *K. Akad. Amsterdam, Proc.* 37. 8. pp. 532-547, 1934.—A mathematical investigation is made of all the possible configurations of the single carbon six-ring when the only forces present are those of "affinity" and the "directing forces." The latter are assumed to be great enough to prevent changes in the valence angles. It follows that there are two types of configuration: one with an infinite number of formations continuously passing into each other, the other with one formation only. The characterising quantities for each formation are given. Analogously, the double six-ring is dealt with but the steric forces and the dipole forces are neglected.

G. C. McV.

22. Molecular Structures of Non-Metallic Halides by Electron Diffraction. L. O. Brockway and F. T. Wall. *Am. Chem. Soc., J.* 56. pp. 2373-2379, Nov., 1934.—The molecular structures of the chlorides and fluorides of carbon, silicon, phosphorus and arsenic and the chloride of tin were investigated by means of electron diffraction. The significance of deviations from additivity of the covalent radii is discussed with respect to ionic character of the bonds and the formation of double electron pair bonds.

AUTHORS.

23. X-Ray Studies of the Molecular Arrangement in Liquids.

S. Katzoff. *J. Chem. Phys.* 2. pp. 841-851, Dec., 1934.—An improved technique has been developed for taking X-ray diffraction photographs of weakly absorbing liquids. Photographs of water, heptane, decane, benzene and cyclohexane have been taken and several hitherto unobserved details have been discovered. The photographs of water have been mathematically investigated by the method of Zernike and Prins, and it was concluded that nearly every molecule has four others around it. No evidence was found either for the definite "quartz-like" arrangement or for the extensive degree of close packing which are postulated by Bernal and Fowler. With the organic compounds there was apparent in every case a striking resemblance of the outer parts of the photographs to electron diffraction photographs of the corresponding vapours. This is in agreement with Debye's prediction and argues for a relatively low degree of periodicity in the liquid structure. It has been shown further that the two outer bands which occur in the photographs of the normal hydrocarbons should appear whenever the molecules of the liquid consist largely of lengths of straight saturated hydrocarbon chain. Some discussion of the structure of the organic liquids has been given. In particular, a theory of the structure of liquid benzene has been postulated and found, using the method of Zernike and Prins, to predict with satisfactory accuracy the observed photograph. The viewpoint which has been found useful in the present discussions is that, to a predominating extent, adjacent molecules in the liquid are held together in very nearly the same manner as in the crystal, while, except for this, the arrangement is random. AUTHOR.

24. Reflections on the Infinitely Little. From Pascal to Heisenberg. **L. Brillouin.** *R.G.E.* 36. pp. 683-698, Nov. 17, 1934.—Quotations are given from the writings of Pascal, Langevin and others, who uphold the principle of determinism and from Bohr, Heisenberg and so forth, who think that indeterminism must apply for very small quantities. The discussion is illuminated by descriptions of experimental results such as radioactive decay and ionisation by α -particles to show that in these cases the classical laws of decay and velocity are only true under certain conditions, and that irregularities are introduced in the first case for substances with low radioactive content and in the second due to the Compton effect. Thus the writer is led to the conclusion that determinism although applicable to macroscopic quantities, has a very unsound basis, whereas indeterminism on the other hand can be applied to atomic as well as macroscopic quantities, but, even so, the true cause and progress of natural phenomena are still unknown. H. M. B.

25. Periodic Property of Atomic Nuclei. **G. Monod-Herzen.** *Comptes Rendus*, 199. pp. 859-860, Oct. 29, 1934.—To each pair of values of the nuclear charge Z and the mass number M there corresponds a nuclear species, the number of which, between Z and $Z + n$ is a periodic function of Z . The curve obtained by representing each nuclear species by a point having coordinates proportional to Z and to M shows minima at $Z = 26$ (Fe), 56 (Ba), 86 (Em), thus dividing the elements into 3 groups, corresponding satisfactorily to those which are deduced from the study of the loss of mass or from considerations of various nuclear theories. Between each of the minima the curve exhibits a definite principal and secondary maxima. The author gives an interpretation of this. W. E. P.

See also Abstracts 26, 68, 211, 227, 228, 231, 245, 246, 250, 301, 307, 309, 310, 318, 321, 322, 323, 332, 355, 370, 380, 477.

COLLOIDS.

26. Connection Between Particle Dimensions of Highly Polymerised Substances and the Viscosities of Their Solutions. R. Obogi and E. Broda.

Kolloid Zeits. 69. pp. 172-178, Nov., 1934.—The viscosities and osmotic pressures of solutions of homogenised acetyl celluloses in acetone have been measured at 25° and 40°. Based on the data obtained, the Staudinger relationship is found to be a useful although only approximate rule up to a particle weight of about 60,000. With higher molecular weights, the errors become too great for definite quantitative deductions from the results. Staudinger's conclusions with respect to the shape and physical properties of these highly polymerised substances may therefore not be valid. The connection between viscosity and molecular weight is found as yet to be only capable of expression as an approximation formula and at present a valid rule cannot be laid down.

H. H. Ho.

27. Preparation of Colloidal Solutions by Silent Electric Discharges. Part II. S. Miyamoto.

Kolloid Zeits. 69. pp. 179-181, Nov., 1934.—By the method previously used, hydrosols and alcosols of arsenic, antimony and mercurous chloride have been prepared, the presence of colloidal particles in the filtered preparations being established with a cardioid dark field condenser. As was expected, the colloidal particles migrate towards the anode. The stability of the sols was investigated. [For Part I see Abstract 3091 (1934).]

T. H. P.

28. Preparation of Hydrosols of Sparingly Soluble Metallic Salts by Electrolysis. N. Peskoff and B. Saprometov.

Kolloid Zeits. 69. pp. 181-185, Nov., 1934.—The method of colloid synthesis described depends on the electrolysis of very dilute salt solutions, in which the anion of the salt forms an insoluble compound with the kation thrust off by the anode. The influence of various factors (current density and strength, temperature, stirring, etc.) has been studied and the conditions favouring the synthesis of the sols established. The method seems widely applicable. Under certain definite conditions the colloidal phase may separate in the shape of ready-formed Liesegang rings.

T. H. P.

29. Wien-Effect in Aqueous Solutions of a Long-Chain Salt.

J. Malsch and G. S. Hartley. *Zeits. f. phys. Chem.* 170. Abt. A. 5-6.

pp. 321-336, 1934.—The Wien effect is the observed departure from Ohm's law for solutions under high field-strengths. Its interpretation according to the theories of Debye, Hückel and Onsager leads to the expectation that ionic aggregates should have a higher mobility than their individual ions, since their net charge increases more rapidly than their friction coefficient relative to the surrounding fluid. Normally, such aggregates have an attendant "atmosphere" of oppositely charged ions which diminish their net charge; hence, in low fields, the equivalent conductivity of the solution will diminish as the aggregates increase in size. In high fields, however, such aggregates will be separable from this "atmosphere" and we may expect the equivalent conductivity to increase with aggregate size, especially at the point where, in colloidal solutions, micelle-formation commences. Experiments with aqueous solutions of cetylpyridinium chloride confirm this prediction, employing the intermittent high fields given by h.f. oscillations. Improvements in the technique for such work are described and the results cover a range of concentrations (up to 0.005 N),

of field-strengths (up to 200 kV./cm.) and of oscillation-periods (4, 16 and 32×10^{-7} sec.).

L. V. C.

***30. Dynamical Investigation of Colloidal Systems. Parts I and II. W. Philippoff.** *Phys. Zeits.* 35, pp. 884-905, Nov. 15, 1934.—Apparatus and technique are described for studying the absorption, by colloidal liquids, of mechanical energy from a system oscillating at frequencies up to 1000 $\sim$. A needle attached to an iron armature is immersed in the liquid in a coaxial capillary; the armature lies between two pairs of pole-pieces, one pair being excited by the anode current of a pentode oscillator and the other being placed in the grid circuit. After adjustment to resonance, the amplitude and frequency of the mechanical oscillations and the anode current are determined. Circuits are fully described and their performance analysed. The dynamical viscosity is derived from the calculated damping coefficients; for normal (Newtonian) highly viscous liquids such as glycerin, honey and gum arabic this is independent of frequency but for liquids of the plastic solid type (e.g. the cellite solutions studied) it decreases rapidly with rising frequency. In Part II the behaviour of cellite solutions is further analysed. Their dynamic viscosity η at frequency ω is given by $\eta = \eta_0[1 + (\omega\tau)^{3/4}]^{-1}$, where η_0 is the extrapolated viscosity for $\omega = 0$; the constant τ corresponds with Maxwell's "relaxation time" (static viscosity/rigidity modulus) and calculated values of the rigidity modulus are shown to agree with those derived from capillary-flow measurements on the same solutions, although Maxwell's equation for the relaxation of shearing stress, $P = P_0 e^{-t/\tau}$, is not valid for these solutions.

L. V. C.

31. Diffusion of Electrolytes in Silica Gel. F. H. MacDougall. *J. Phys. Chem.* 38, pp. 945-949, Oct., 1934.—Patrick and Allan, from experiments on the diffusion of soluble chlorides and HCl in silica gel [see Abstract 4000 (1934)], concluded that Nernst's theory of diffusion did not apply to such systems, since they observed that the diffusion of the acid was speeded up in the presence of salt, the diffusion of the latter being slowed down in the presence of acid. The present author shows these observations to be in essential qualitative and quantitative agreement with Nernst's theory. The absolute diffusion coefficients observed were less than those to be expected from the mobilities of the ions concerned, but this is ascribed to the fact that in a gel-structure only the interstices in the structure are available for salt-diffusion; in other words, the effective cross-section is less than that of the gel test-pieces themselves.

L. V. C.

32. Liesegang Phenomenon in Silicic Acid Gel. A. T. Lincoln and J. C. Hillyer. *J. Phys. Chem.* 38, pp. 907-917, Oct., 1934.—Description of the preparation of Liesegang rings of copper chromate, mercuric iodide, lead chromate, lead iodide, lead sulphate, basic bismuth bichromate and metallic mercury in silicic acid gel. In the lead formate preparation, the rings were formed simultaneously throughout the specimen after several days' standing. The banding is most perfect and extends furthest into the tube where the ratio of concentrations of the reacting substances is greatest.

A. S. C. L.

33. Submicroscopic Structure of Artificial Silk. K. Ohara. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No. 534.* pp. 152-158, Nov., 1934. *In German.*—Investigation of the coagulation structure of viscose-, Lilienfeld-, nitro-, Bemberg- and acetate-rayons, shows that these silks possess a thin skin. Below this, in the case of viscose- and nitro-silks, a rind layer and an inner layer may be distinguished. With Bemberg

rayon, the centre of the thread is occupied by a zone of circular section which is capable of intense coloration by impregnation with silver or gold. Metachromatic staining indicates that the skin and the rind layer are of denser structure than the inner layer. Both in the piece and in cross-section, the threads can be coloured dichroically with gold. T. H. P.

34. Autophotographic Localisation of Radioactive Ions in Gelatin. Suzanne Veil. *Comptes Rendus*, 199. pp. 1044–1046, Nov. 12, 1934.—A strip of gelatin impregnated with BaCl_2 containing RaCl_2 , is electrolysed [see Abstract 4316 (1933)], and then placed against a photographic plate. The diffusion movements of the radioactive ions are then readily traced. C. A. S.

See also Abstracts 75, 94, 133, 135, 386.

CRYSTAL STRUCTURE AND PROPERTIES.

35. Properties of Crystals. A. Smekal. *Zeits. f. techn. Physik*, 15. 11. pp. 405–413, 1934.—The paper is principally concerned with the behaviour of single crystals. Emphasis is laid on the importance of structural flaws in the theory of the single crystal. Experiments on single crystals of rock-salt are described in which structural flaws are made visible photochemically. J. T.

36. Isomorphism between Compounds of Elements of Dissimilar Valencies. G. Bruni and A. Ferrari. *Zeits. f. Krist.* 89. pp. 499–504, Nov., 1934. *In Italian*.—The transition from the lattice of LiCl to that of MgCl_2 is discussed. The structure of chlorides of the MgCl_2 type is derivable from that of the univalent chlorides (LiCl type) by retaining the arrangement of the Cl anions but leaving empty one-half of the places occupied by the univalent kations. If two-thirds of the places of the kations remain vacant, the lattice of a trivalent chloride is obtained. The similar isomorphism between complex nitrites with different numbers of kations is illustrated by the formulæ: $\text{Me}_4^{\text{I}}[\text{Me}^{\text{II}}(\text{NO}_2)_6]$; $\text{Me}_3^{\text{I}}[\text{Me}^{\text{III}}(\text{NO}_2)_6]$; $\text{Me}_2^{\text{II}}[\text{Me}^{\text{II}}(\text{NO}_2)_6]$; $3/2\text{Me}^{\text{II}}[\text{Me}^{\text{III}}(\text{NO}_2)_6]$. These phenomena of isomorphism with partial lattice-occupation are explained by the fact that the lattice structure is determined essentially by the anions, the kations taking up only an inappreciable fraction of the total volume. T. H. P.

37. Crystal Figure Measurement. H. Tertsch. *Zeits. f. Krist.* 89. pp. 594–600, Dec., 1934.—The general solution of the problem of dealing with parallel-perspective figures to obtain every section and crack, on the assumption of orthogonal construction. F. I. G. R.

38. Unidimensional Space-Groups. E. Alexander. *Zeits. f. Krist.* 89. pp. 606–607, Dec., 1934.—An error in the author's previous paper on this subject [see Abstract 2925 (1929)] is discussed. It is shown that two of the space-groups previously considered have no independent meaning. J. T.

39. Applications of Bloch Theory to Study of Alloys and of Properties of Bismuth. H. Jones. *Roy. Soc., Proc.* 147A. pp. 396–417, Nov. 15, 1934.—The ϵ and η phases of binary alloys are considered on the Bloch theory. A qualitative explanation is given of the observed variations of crystal parameter within these phases, and also of the electron-atom ratio at which the ϵ phase begins. The theory also shows why Bi does not form a coordination lattice. The diamagnetism of pure Bi is deduced, also that of BiSn and BiTe alloys. The values of the magnetostriction and

electrical conductivity of Bi are deduced from the theory and are found to be in good agreement with experiment. J. T.

40. Spectrum of the Frequencies of a Polar Crystal Lattice. M. Born and J. H. C. Thompson. *Roy. Soc., Proc.* 147A. pp. 594-599, Dec. 1, 1934.—The importance of the knowledge of the frequency spectrum of a crystal lattice is discussed. A method for its determination is briefly outlined. AUTHORS.

41. Effect of Cutting Single-Crystal Plates of Aluminium with Knife Edge. S. Isotani. *Kyoto Coll. Sci., Mem.* 16. pp. 353-356, Sept., 1933. *In English.*—The effect of cutting an aluminium plate composed of a large single crystal with a knife edge was investigated by means of X-rays. When a single-crystal plate of aluminium was cut with a knife edge, the single crystal was broken up into microcrystals, and they were so arranged in an imperfectly fibrous manner that the axis of the fibre was parallel both to the cut made by the knife edge and to the plane of the test-piece irrespectively of the initial orientation of the crystallographic axes of the single crystal. As for the relationship between the maximum angle of rotation of the microcrystals around the fibre axis, the thickness of the test-piece and the angle of the knife edge, it was found that the maximum angle of rotation of the microcrystals decreased almost in a linear relation according as the test-piece became thicker, irrespectively of the velocity of the cutting, and also slightly decreased when the angle of the knife edge increased. The range of the influence of the cutting upon the test-piece increased almost in a linear relation with increase of the thickness of the test-piece, and slightly decreased with increase of the angle of the knife edge. AUTHOR.

42. Change of the Width of X-Ray Interference Lines of Palladium by Electrolytic Charging with Hydrogen. E. Nähring. *Ann. d. Physik*, 21, 3. pp. 303-319, Nov., 1934.—Measurements of lattice constants in dependence on the duration of charge were carried out and the results of other investigations on this subject were confirmed. A widening of the interference lines by the electrolytic charging was found. The widening of the lines obtained in dependence on the glance angle shows an anomalous behaviour with charged Pd, from which it is concluded that the cubic crystal lattice of Pd changes its symmetry on charging with H, whereby, however, new lines do not appear, but only a widening of the lines is discoverable. The particular kinds of lattice disturbances are discussed and a picture drawn of the electrolytic charging with H. J. J. S.

43. Structure of FeAl_3 . E. Bachmetew. *Zeits. f. Krist.* 89. pp. 575-586, Dec., 1934.—The structure of FeAl_3 is determined from Laue, rotation, oscillation and powder photographs. It is orthorhombic with $a = 47.43 \text{ \AA}$, $b = 15.46 \text{ \AA}$, and $c = 8.08 \text{ \AA}$. The space group is V_h^{23} and the number of atoms in the unit cell is 400. The atomic positions are not worked out. J. T.

44. Gold-Copper Alloys. L. Vegard and A. Kloster. *Zeits. f. Krist.* 89. pp. 560-574, Dec., 1934.—Au-Cu alloys are examined by means of a precision X-ray camera at various temperatures. At 475°C . the atomic distribution is random and compounds cannot exist. The system consists at this temperature of a continuous series of solid solutions but the additivity law does not hold. As far as can be told, the departure from the law at high temperatures is in the same sense as that at room-temperature. No lines corresponding to a compound are found at room-temperature. J. T.

45. Structure of Mercuric Chloride. H. Braekken and W. Scholten. *Zeits. f. Krist.* 89. pp. 448-455, Nov., 1934.— HgCl_2 is rhombic, a 5.963, b 12.735, c 4.325 Å, with 4 mol. in the unit cell; space group $Pmnb$ (V_h^{16}). The structure is molecular, the atoms in the molecule are in a straight line, $\text{Hg}-\text{Cl} = 2.25$, and (in different molecules) $\text{Cl}-\text{Cl} = 3.4$ Å. C. A. S.

46. Structure of Lithium Sulphate Monohydrate. G. E. Ziegler. *Zeits. f. Krist.* 89. pp. 456-461, Nov., 1934. *In English.*— $\text{LiSO}_4 \cdot \text{H}_2\text{O}$ is monoclinic, a 5.43, b 4.83, c 8.14 Å, β $107^\circ 35'$, with 2 mol. in the unit cell: space group C_2^2 ($P2_1$). The Li and S atoms are at the centres of slightly distorted tetrahedra, one O of the LiO_4 tetrahedra being that of H_2O , the others each of a different SO_4 group; each O forms a corner of two tetrahedra; $\text{Li}-\text{O} = 1.97$ and 1.99 , $\text{O}-\text{O} = 3.15$ and 3.24 Å; in the SO_4 tetrahedra $\text{S}-\text{O} = 1.48$, $\text{O}-\text{O} = 2.43$ Å. C. A. S.

47. Crystal Form and Space Lattice of Zirconium Tetrafluoride and Hafnium Tetrafluoride. G. E. R. Schulze. *Zeits. f. Krist.* 89. pp. 477-480, Nov., 1934.—These compounds are monoclinic, with the following lattice constants.

	a	b	c	β	Density (calc.)
ZrF_4	9.46 Å	9.87	7.64	$94^\circ 30'$	4.66
HfF_4	9.45 Å	9.84	7.62	$94^\circ 29'$	7.13

The space group is C_{2h}^6 for both, and the elementary cell contains 12 molecules. F. I. G. R.

48. Structure of Vitreous BeF_2 . B. E. Warren and C. F. Hill. *Zeits. f. Krist.* 89. pp. 481-486, Nov., 1934. *In English.*—An X-ray diffraction pattern of vitreous BeF_2 has been made using strictly monochromatic radiation. Based upon the random network picture of the vitreous state, a scattering curve is calculated which is in satisfactory agreement with the experimental curve. BeF_2 , SiO_2 , and GeO_2 all have the same tetrahedral type of vitreous structure. The satisfactory agreement between calculated and experimental scattering curves for these three isomorphous glasses is a convincing verification of the random network hypothesis. The general problem of the interpretation of glass diffraction patterns is discussed. AUTHORS.

49. Structure of Sulphohalite. A. Pabst. *Zeits. f. Krist.* 89. pp. 514-517, Nov., 1934. *In English.*—The structure of sulphohalite, $2\text{Na}_2\text{SO}_4 \cdot \text{NaCl} \cdot \text{NaF}$, has been determined from a powder pattern. The structure is cubic face-centred and there are four formula units in the unit cell, $a_0 = 10.08 \pm 0.01$ Å. From a consideration of atomic radii positions can be assigned to all atoms which give good agreement of observed and calculated intensities. AUTHOR.

50. Atomic Arrangement in Potassium Trithionate Crystals and Structure of Trithionate Radical. W. H. Zachariasen. *Zeits. f. Krist.* 89. pp. 529-537, Dec., 1934. *In English.*— $\text{K}_2\text{S}_3\text{O}_6$ is holohedral orthorhombic with a 9.77, b 13.63, c 5.76, and 4 mol. in the unit cell; space group $Pnam$ (V_h^{16}). The $\text{S}_3\text{O}_6^{2-}$ radical has the structure $\text{O}_3\text{S}_1 \cdot \text{S}_{II} \cdot \text{S}_1\text{O}_3$, O_3 and S_{II} surrounding each S_1 approximately tetrahedrally with
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$S - O = 1.50 \text{ \AA}$, $S - S = 2.15$, and the angle between the two $S_{II} - S_I$ bonds 103° . The K atoms lie between the S_3O_6'' groups in two sets $K - O$ averaging 2.88 and $2.94 \text{ \AA}$; both have coordination number 9 [see Abstract 1412 (1934)].
C. A. S.

51. Crystals of Methylephedrine Hydrochloride, Hydrobromide and Hydriodide. B. Gossner and H. Neff. *Zeits. f. Krist.* 89. pp. 417-426, Nov., 1934.—In accord with the fact that they form crystals of the rhombic disphenoidal class, these salts of the *l*-base exhibit marked piezoelectric effects, whereas those of the *dl*-base, which form crystals of the monoclinic-prismatic or triclinic-pinacoidal class, are not piezoelectric. Study of these salts serves to confirm the view that the independent crystal lattice of the racemate is arrived at by combination of the *d*- and *l*-compounds after the manner of a double compound.
T. H. P.

52. Cholesteryl Salicylate. S. B. Hendricks. *Zeits. f. Krist.* 89. pp. 427-433, Nov., 1934. *In English*.—Interpretation of X-ray diffraction data for cholesteryl salicylate. It is pointed out that dimensions of units of structure need not necessarily be related to dimensions of the constituent molecules. This substance also forms a liquid crystalline phase and it is suggested that molecules containing NR or OR_2 groups (where R is any group other than H) are liable to form liquid crystals owing to the approximate orthogonality of the oxygen and nitrogen valencies.
A. S. C. L.

53. Structure of Oxalic Acid Dihydrate and Structure of Oxalate Radical. W. H. Zachariasen. *Zeits. f. Krist.* 89. pp. 442-447, Nov., 1934. *In English*.— $H_2C_2O_4 \cdot 2H_2O$ is monoclinic, $a \ 6.12$, $b \ 3.61$, $c \ 12.03 \text{ \AA}$, $\beta \ 106^\circ 12'$, with 2 mol. in the unit cell, space group $P2_1/n$. The oxalate radical is plane, $C - C = 1.59$, and $C - O = 1.25 \text{ \AA}$, the two $C - O$ bonds are inclined at 126° , and all the four O atoms are equivalent. The hydrate is probably to be regarded as oxonium oxalate, $(OH_3)_2C_2O_4$. [See Abstract 1631 (1927).]
C. A. S.

54. Spectrometric Measurements on Hexamethylene-tetramine and Urea. R. W. G. Wyckoff and R. B. Corey. *Zeits. f. Krist.* 89. pp. 462-468, Nov., 1934. *In English*.—Powder and ($0kl$) single crystal spectrometric reflection intensities are recorded upon hexamethylene-tetramine and urea. Fourier analyses utilising the reflection F 's thus obtained give atomic positions close to those previously found for both crystals. The carbon, oxygen and nitrogen F -curves indicated by these intensity data are discussed.
AUTHORS.

55. Structure of Dimethyl Ammonium Chlorostannate. R. B. Corey and R. W. G. Wyckoff. *Zeits. f. Krist.* 89. pp. 469-476, Nov., 1934. *In English*.—Laue and oscillation photographs show that the orthorhombic unit cell of $[(CH_3)_2NH_2]_2SnCl_6$ contains two molecules and has the dimensions $a_0 = 7.26 \text{ \AA}$, $b_0 = 7.38 \text{ \AA}$, $c_0 = 14.28 \text{ \AA}$. The space group is C_{2v}^2 with eight Cl atoms in general positions (*b*) and the other atoms in special positions (*a*) where $XYZ = acb$. Spectrometric measurement of all reflections from (hkl) planes for which $2\theta < 110^\circ$ and estimated intensities of 75 ($0kl$) reflections found on oscillation photographs fix the 24 atomic parameters.
AUTHORS.

56. Crystal Structure of Barium Succinate. E. Hertel and G. H. Römer. *Zeits. f. phys. Chem.* 27. Abt.B. 3-4. pp. 282-286, 1934.—The dimensions of the unit cell of this salt, which contains 4 mols., are $I_a = 7.57 \text{ \AA}$, $I_c = 10.28 \text{ \AA}$. The crystals are tetragonal, the translation group being Γ'_4 and the space group D_{4h}^{19} . The crystal lattice is a typical
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ion lattice, the underlying principle being the formation of chains according to the scheme: $\text{Ba}^{2+} - \text{O}_2\text{C}-\text{CH}_2-\text{CH}_2-\text{CO}_2-\text{Ba}^{2+} - \text{O}_2\text{C}-\text{CH}_2-\text{CH}_2-\text{CO}_2^- - \text{Ba}^{2+} \dots$. The length of a chain member corresponds with the identity period $I_c = 10.28 \text{ \AA}$. The separate ionic chains are arranged along the [001] axis. Relationships between the structure of barium succinate and those of calcium carbide and the alkylammonium halides, and analogy with the structure of zircon, are indicated. T. H. P.

57. Crystallography of Guanidine Mono-, Di-, and Tri-chromates. A. Swaryczewski. *Acad. Polonaise Sci. et Lettres, Bull.* 5-7A. pp. 246-255, May-July, 1934. In German.—The monochromate, $(\text{CH}_5\text{N}_3)_2, \text{H}_2\text{CrO}_4$, forms triclinic crystals of $d \ 2.301$; $a : b : c = 1.1013 : 1 : 1.041$; $\alpha = 82^\circ 34'$, $\beta = 90^\circ 10'$ and $\gamma = 53^\circ 20'$. The dichromate, $(\text{CH}_5\text{N}_3)_2, \text{H}_2\text{Cr}_2\text{O}_7$, forms monoclinic crystals of $d \ 2.502$; $a : b : c = 0.8232 : 1 : 0.6942$, $\beta = 100^\circ 0'$. The trichromate, $(\text{CH}_5\text{N}_3)_2, \text{H}_2\text{Cr}_3\text{O}_{10}$, forms monoclinic crystals of $d \ 2.595$; $a : b : c = 1.686 : 1 : 2.138$, $\beta = 122^\circ 48'$. Optical and other properties are given. T. H. P.

58. Orientation of Impurity Molecules in Crystals. K. S. Krishnan and P. K. Seshan. *Zeits. f. Krist.* 89. pp. 538-540, Dec., 1934. In English.—From a study of the polarisation of the absorption and fluorescence bands of naphthacene detectable in ordinary "pure" chrysene and anthracene, it is inferred that the naphthacene molecules are orientated parallel to those of chrysene or anthracene. Similarly molecules of fluorene present as an impurity in diphenyl are orientated parallel to those of diphenyl. The vibration that is more absorbed excites fluorescence more strongly. C. A. S.

59. Swarm Theory of Liquid Crystals. L. S. Ornstein. *Kolloid Zeits.* 69. pp. 137-155, Nov., 1934.—This paper gives a comprehensive survey of liquid crystal phenomena (of the nematic type) from the standpoint of the swarm hypothesis. The conception of swarm or colony is treated in full, and the hypothesis itself formulated and derived from a molecular basis. The phase standpoint is also considered, while a survey is given of phenomenal applications of the swarm hypothesis to the description of the macroscopic properties, to turbidity, to the influence of magnetic and electric fields upon turbidity and upon the electrical and magnetic properties of the liquid crystal phase, to X-ray photographs, to gravitational phenomena, and to dielectric losses. Further the marginal influences are described and quantitatively explained. H. H. Ho.

60. Velocity of Crystallisation of Sucrose. K. Smoleński and A. Zelazny. *Acad. Polonaise Sci. et Lettres, Bull.* 3-4A. pp. 172-189, March-April, 1934. In French.—The procedure employed consists in seeding a supersaturated solution of sucrose with a certain quantity of "fine grain" and in determining the quantity of sugar crystallising out by measuring the concentration of the mother-liquor refractometrically. This can be done without separating the crystals from the solution. The velocity of crystallisation of sucrose at 25° (1) in pure solutions with supersaturation coefficients varying between 1.1 and 1.5, and (2) in solutions with added molasses and with degrees of purity ranging from 95 to 80. In pure solutions, without shaking, the velocity is expressed exactly by: $v = dx/dt = KF(n_0 - x)^2/n_0$, where F is the surface area of the crystals, n_0 the initial supersaturation and x the amount of sugar crystallised per 100 gm. of water. Crystallisation of solutions of purity 95-80 is difficult to express by any simple formula. When the coefficient of initial supersaturation is 1.3,

the crystallisation of sucrose is about twice (or 9 times) as slow in solutions of purity 95 (or 90) as in the pure solutions. T. H. P.

61. Growing Magnesium Crystals. M. Straumanis. Zeits. f. Krist. 89. pp. 487-493, Nov., 1934.—When Mg crystals grow in the vapour, crystals of the equilibrium form, bounded by 0001, $10\bar{1}0$ and $10\bar{1}1$, are formed, together with others which show only some of the faces while the rest consists of a curved surface of shining appearance; internally, however, such crystals are of individual structure. Microscopic investigation shows that, when crystal growth begins and specially when the supersaturation is marked, crystal nuclei without external faces may form. As the nucleus enlarges, the rate of growth diminishes and the faces of the equilibrium form, preceded by the vicinal faces, begin to appear. As the conditions of growth approach those of the equilibrium, the vicinal faces disappear. Besides these indefinite faces and the face $10\bar{1}3$, observed in a single case, no others characteristic of the non-equilibrium crystal were found. T. H. P.

***62. Glide-Hardness and Anisotropy. H. Tertsch. Zeits. f. Krist. 89. pp. 541-552, Dec., 1934.**—An apparatus consisting of a small pencil and substage (the latter made of steel), enables a determination to be made of the vectorial hardness for gliding in definite directions. The results using calcite agree essentially with Pfaff's investigations. F. I. G. R.

63. Fatigue and Crystal Recovery in Aluminium. H. A. Smith. Physics, 5. pp. 412-414, Dec., 1934.—The previous X-ray work on fatigue in metals is reviewed. Such work has been confined to copper, silver and steel. The present note reports on the results of an investigation of service fatigue fractures in h.v. transmission cables made of commercially pure aluminium. The crystals composing the shallow surface layer of the fractures were found to have recovered sufficiently from the microscopic distortion due to cold drawing that individual monochromatic diffraction spots could be identified. Two possible contributing causes are suggested to explain this crystalline recovery. AUTHOR.

64. Plastic Properties of Single Crystals of Silver and Thallium Halides. A. W. Stepanow. Phys. Zeits. d. Sowjetunion, 6. 3. pp. 312-315, 1934. In English.—The stretching tension-strain diagram of a single crystal of AgCl has been determined, the deformation externally resembling that of a typical metallic crystal but with no contraction before rupture; the flow limit of a non-annealed crystal is 1500 gm./mm.², the elastic limit of an annealed one 70 gm./mm.². The slip plane and direction of slip are both (110). At -185° rupture occurs without extension at 5200 gm./mm.². AgBr, TiCl and TiBr behave similarly. The deformation work of AgCl is less than that of NaCl, though the lattice energy is greater. To explain the first stage of the process it is suggested that the external force causes a change in distance between the atoms or ions, and consequent conversion of the particles constituting the lattice into dipoles, a state of non-equilibrium resulting. Deformation consists in bringing this portion of the lattice back to a state of equilibrium, the resultant transitions taking place in definite planes and directions where such transitions are accompanied by an output of energy. C. A. S.

65. Application of Valouch's Method of Measuring Lattice Constants to that of Kunz and Köppel. F. Bouchal and V. Dolejšek. Comptes Rendus, 199. pp. 1054-1056, Nov. 12, 1934.—Valouch's method [see *Bull. Acad. Sci. Bohême*, 44, 1, 1927], exemplified by application to the

1011 face of quartz, gives a result ($d_{\infty} = 3336.2 \text{ X}$) of equal accuracy with that of Kunzl and Köppel [see Abstract 2723 (1934)]. A recalculation of Siegbahn and Dolejšek's result for the prismatic face of quartz brings it into agreement with that of Bergqvist ($d = 4244.92 \text{ X}$) [see Abstract 1786 (1931)]. C. A. S.

66. Simple Determination of Spacial Orientation in Crystals. H. Ekstein and W. Fahrenhorst. *Zeits. f. Krist.* 89. pp. 525-528, Nov., 1934.—A rotation photograph, and any Laue photograph will serve, without the fulfilment of special conditions. When the lattice is known, the method is at once applicable to the triclinic case. F. I. G. R.

67. Indexing of Rotation Photographs. N. J. Seljakow and E. I. Sows. *Zeits. f. Krist.* 89. pp. 601-606, Dec., 1934.—A graphical method of indexing rotation photographs taken about any axis is described. A rotation photograph of an Al single crystal rotated about the cube edge is worked out as an illustration of the method. J. T.

68. Hydration of Salts with Heavy Water and Constitution of Salt Hydrates. J. N. E. Day, E. D. Hughes, C. K. Ingold and C. L. Wilson. *Chem. Soc., J.* pp. 1593-1599, Oct., 1934.—The binding of water of hydration of crystalline salts has been examined by measurements of the distribution of heavy water between solute and solvent water. The results suggest that any binding structure is loose and evanescent. A. S. C. L.

69. Laue Diagrams of Deformed Crystals. W. F. Berg. *Zeits. f. Krist.* 89. pp. 587-593, Dec., 1934. *In English.*—General deformation gives rise to Laue spots which (for reflected X-rays) are smeared out in all directions. Transmitted X-rays give radially elongated spots. F. I. G. R.

See also Abstracts 23, 126, 222, 295, 353, 361, 385, 445, 476, 479, 480, 518.

DENSITY.

***70. Density of Liquid Iodine.** T. Nayder. *Acad. Polonaise Sci. et Lettres, Bull.* 5-7A. pp. 231-238, May-July, 1934. *In German.*—Billet's values for the density of liquid iodine are often used, but he employed an impure sample. Nayder has determined the density of Schuchardt's "Jod. Puriss. Resublimatum" by a sinker method. A quartz sinker was suspended in liquid iodine by a platinum wire suspended from one arm of a balance and passing through an electrically heated vertical glass tube 70 cm. long, sealed to the upper part of the vessel containing the sample. A similarly heated tube also connected to the upper part of the vessel led to a condensation vessel kept at a slightly reduced pressure to prevent iodine vapour from rising up the vertical tube and condensing on the suspension wire. The containing vessel was heated in an oil thermostat. A second sample of iodine was investigated using a second sinker. The greatest divergence of any determined density from the mean temperature-density straight line was about 0.002 gm./cm.^3 The equation $d = 3.94916 + 0.003267(120-t)$ was derived. The density determined just above the melting point is about 1 % less than the values of Billet and of Ramsay and Drugman. The latter's values for the halogens are all slightly high as compared with those of other observers, indicating a systematic error therein. P. H. B.

71. Density and Constitution of a Pure Normal Liquid. R. Lautié. *Comptes Rendus*, 199. pp. 932-934, Nov. 5, 1934.—Experiment shows that in the case of a pure normal liquid or pure liquid slightly

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dissociated the surface tension γ , the difference Δ between the absolute density (in equilibrium with its vapour of absolute density d) and d , and the height h of the liquid in a capillary tube of internal radius r , are expressible as simple exponential functions of the characteristic temperature θ thus: $\gamma = \frac{1}{2}gh\Delta = k_1\theta^x$; $h = k_2\theta^y$; $\Delta = k_3\theta^z$. It is shown that for a normal liquid x, y, z are practically constants independent of θ and of the nature of the molecule, and that k_1, k_2 and k_3 may be calculated *a priori* from the molecular structure.

H. L. B.

72. Physical Properties of Aliphatic Acetylenes. F. R. Morehouse and O. Maass. *Canad. J. of Research*, 11. pp. 637-643, Nov., 1934.—This paper deals with the preparation and determination of the physical properties of the lower members of the acetylene series—methyl, ethyl, dimethyl and propyl acetylenes. A comprehensive determination of the physical properties of these compounds has been made and the results have been interpreted along with similar data obtained for the paraffin and olefine series. The acetylenes have been found to differ from the paraffins and olefines. The difference is attributed to the polarity of the acetylenes as a group. This is further substantiated by a comparison of the properties of the two isomeric acetylenes, dimethyl and ethyl acetylenes.

AUTHORS.

***73. Microvolumenometer.** H. Hauptmann and G. E. R. Schulze. *Zeits. f. phys. Chem.* 171. *Abt. A.* 1-2. pp. 36-40, 1934.—A new type of volumenometer is described, which allows of the determination of the density of a solid correct to 1 % using only 0.01 cm.³ The performance of the apparatus is exemplified by results for powdered quartz and copper wire.

L. A. W.

See also Abstracts 388, 389.

DIFFUSION AND OSMOSIS.

***74. Diffusion in Liquids. Parts VI-X.** R. Fürth, R. Zuber and K. Sitte. *Zeits. f. Physik*, 91. 9-10. pp. 609-656, Oct. 14, 1934.—A micro-diffusion apparatus is developed for coloured and uncoloured liquids at very low concentrations. The results are considered in the light of the theory of the boundary layer in dilute solutions of electrolytes. The method of investigation is extended to the reciprocal diffusion of dilute solutions of electrolytes and the results were in agreement with the results of calculation. The p.d. between two dilute solutions of electrolytes in contact with each other is discussed from the point of view of diffusion changes. [For Parts I-V see Abstract 861 (1933).]

F. J. B.

75. Anomalous Diffusion. D. Krüger and H. Grunsky. *Zeits. f. phys. Chem.* 170. *Abt. A.* 3-4. pp. 161-171, 1934.—The anomalous distribution observed in the investigation of diffusion in solutions of cellulose derivatives by Oeholm's or similar method is discussed. It is shown that the results previously obtained for cellulose derivatives are inapplicable to the calculation of diffusion coefficients and also of the mean molecular weight. The conclusions are in opposition to those of Herzog and Kudar. [See Abstract 336 (1931).]

F. J. B.

76. Diffusion in the Nickel-Copper System. C. Matano. *Kyoto Coll. Sci., Mem.* 16. pp. 249-259, July, 1933. *In English*.—With the samples (i) a thin copper deposition on a nickel plate, (ii) a thin nickel deposition on a copper plate, and (iii) thin alternate layers of electrodeposited nickel and copper, heated at the temperatures of 500, 650 and

900° C. for various time intervals, the diffusion phenomena of the nickel copper system were studied by the X-ray method. From the results of the experiments, it is concluded that in a wide range of concentrations, the value of the coefficient of diffusion can not be a constant but varies from 10^{-7} to 10^{-9} cm.²/day or more widely at 500° C.; but if the experiments are carried out under the same conditions with regard to the state of the samples, the coefficient of diffusion D can be roughly expressed by the formula $D = Ae^{-\frac{\beta}{T}}$, where T is the absolute temperature, and A and β are constants independent of T , although they depend on the concentration.

AUTHOR.

77. Diffusion of Elements in the Solid State. B. N. Sen. *Comptes Rendus*, 199. pp. 1189–1190, Nov. 26, 1934.—A table is given of the minimum distance of approach of the atoms of various elements by Bragg, and it is found that, for diffusion of two solids into one another the following rule holds: diffusion is possible in such a direction that the substance in which the atoms approach more nearly penetrates into the one of greater distance. This is found to be similar to the formation of amalgams but a very much slower process.

H. M. B.

78. Mobility of Gold in Solid Lead. W. Seith and H. Etzold. *Zeits. f. Elektrochem.* 40. pp. 829–832, Dec., 1934.—The solubility of gold in lead is determined at temperatures from 170 to 208° C. and the rate of diffusion of gold in lead is measured between 113 and 300° C. A series of experiments in which electric currents are passed for long times through rods of lead-gold alloy shows an increase of gold concentration at the positive end, from which a transport number of about 10^{-10} is deduced. Similar experiments with silver give no positive result. It is found impossible to detect any effect of increased pressure (estimated at 1000 atmospheres) upon velocity of diffusion.

L. A. W.

See also Abstracts 15, 31, 32, 34, 130, 388.

ELASTICITY AND PLASTICITY.

79. Theory of Bending. C. Sunatani. *Tohoku Univ., Technol. Reports*, 11. 3. pp. 1–11, 1934. *In English*.—Reference is made to St. Venant's methods for the solution of the elasticity of a straight beam when the plane of bending (1) contains one of the principal axes of the moment of inertia of a cross section at its centroid, and (2) is in any direction. It is shown that the latter case can be solved directly by taking the neutral axis as one of the coordinate axes without breaking the problem into the two cases in which the two principal axes are contained by different planes of bending and then combining the two. The theory for a twisted prismatic bar can be derived from the theory for a straight beam. In addition τ_0 in a cross section which is symmetrical about the line of shearing force has been proved to vanish and the laws of similarity for the shear stresses xz and yz have been established for the convenience of the determination of these stresses in similar beams.

R. S. R.

80. Theory of Hardness. A. W. Stepanow. *Zeits. f. Physik*, 92. 1–2. pp. 42–60, Nov. 2, 1934.—The hypothesis is put forward that the many inconsistencies found in the measurements of hardness can be explained by assuming that the hardness depends on the degree of plastic deformation present, both on the surface and in the interior of the test piece. On this theory the author explains, among other things, the low

hardness values found for plastic crystals, and the dependence of hardness on experimental conditions.

J. T.

81. Deformation of Thin Cylindrical Shells Subjected to Internal Loading. I. A. Wojtaszak. *Phil. Mag.* 18. pp. 1099-1116, Dec., 1934.—Two problems on deformation of thin cylindrical shells are discussed, viz., (1) a complete circular cylindrical shell freely supported at its edges and subjected to internal hydrostatic pressure, (2) a portion of a cylindrical shell cut from a circular cylinder by two diametral sections and two cross sections normal to the axis of the cylinder. In both cases, rapidly convergent trigonometric series represent the deformations. Numerical examples are given, and it is shown that the rigidity of a curvilinear rectangle increases rapidly with increase of central angle subtended by the rectangle.

J. S. G. T.

82. Compressibility Equation for Water. E. Brander. *Soc. Scien. Fennica, Comm. Phys.-Math.* 7. 7. [6 pp.], 1934. In German.—A new compressibility equation for dilute electrolytes is developed, together with an expression for the volume-change accompanying dissociation, from Tammann's theory of internal pressure in conjunction with Ostwald's dilution law and Planck's thermodynamic equation, $\partial \log_e k / \partial p = -\Delta v / RT$, where k is the dissociation constant at p , v and T . The compressibility equation is applied with good agreement, up to 6000 kg./cm.², to Bridgman's data for water.

L. V. C.

83. Compressibility Coefficients of Solutions of Eight Alkali Halides. A. F. Scott, V. M. Obenhaus and R. W. Wilson. *J. Phys. Chem.* 38. pp. 931-940, Oct., 1934.—Compressibility coefficients for solutions of LiCl, LiBr, NaCl, NaBr, NaI, KCl, KBr and KI covering a wide range of concentrations have been measured for the pressure interval 100-300 megabars using Mair and Lanman's apparatus [see Abstract 1427 (1934)]. Plotting compressibility against concentration (wt. per cent) gives curves sensibly straight for the bromides, concave upwards for the chlorides and concave downwards for the iodides. At certain concentrations the curves for lithium salts show anomalies which are collated with anomalies in other properties at these concentrations.

L. V. C.

***84. Electrically-Maintained Vibrating Reed for Determination of Young's Modulus. Part II. Experimental.** E. G. James and R. M. Davies. *Phil. Mag.* 18. pp. 1053-1086, Dec., 1934.—Following the theoretical investigation made in Part I [see Abstract 4838 (1934)] experiments are made with a carefully constructed apparatus of coils which are used to produce forced vibrations in a reed with a heavy stallo bob. The resistance, inductance and pulsance of the system are measured by the Rayleigh and frequency bridges and the amplitude of the oscillation of the reed by a microscope. Graphs of all results are given. It is shown that the maximum amplitude and maximum impedance of an electrically driven reed depends not merely on the dimensions and material of the reed, but also on the magnitude of the polarising and driving fields and the air-gap between reed and pole-pieces. This method applied to the measurement of Young's modulus gives a value correct to 1 in 1000 compared with statical methods, and should be an excellent way of obtaining Young's modulus for crystals and other substances available as small bars.

H. M. B.

85. Plastometric Investigation of Highly Consistent Substances. Part II. G. Ungar. *Kolloid Zeits.* 69. pp. 164-172, Nov., 1934.—This paper deals with the use of the hemispherical plastometer [see Abstract 4839 (1934)] for the determination of shear-curves and for the evaluation

of absolute shear-constants. In the cases of such highly consistent plastic substances as potter's clay deficient in water, glazes, plastiline and solid fats, which all exhibit great inclination to form cleavage planes and other structural disturbances, only the thrust-elasticity could be determined. On the other hand exact shear curves were obtained for clays rich in water, pastes and dough, mineral powders kneaded into strong syrups and dextrine solutions; these curves are fully described and discussed. By means of three material constants for the apparent tenacity, the flow phenomena may be very accurately described. It is found that for plastic flow the linear formula is valid both for vanishing low and very high shear gradients. A number of curves have been derived by the power series method and by this means the series development of the shear-gradient pressure relationships obtained.

H. H. Ho.

86. Measurement of Stress by Means of Optical Double Refraction. L. Föppl. *Zeits. f. techn. Physik*, 15. 11. pp. 430-436, 1934.—A brief review of the photoelastic stress measurements that have been carried out during the past year. The author begins by giving an account of the physical principles underlying this method of stress measurement and goes on to divide the problems dealt with into two groups. The first group deals with problems connected with the influence of the shape of the test-piece, such as notches, curves, holes, etc., on the stress distribution. The second group deals with the temporary state of stress due to interrupted loading. Examples are given of both groups.

R. L.

87. Self-Maintained Oscillations. J. Haag. *Comptes Rendus*, 199. pp. 906-909, Nov. 5, 1934.—Periodic oscillations can be interpreted by a simple geometric method, which results in the determination of cycles of a certain differential equation of the first order and a curve Γ associated with the particular cycles. The most general form of cycles and associated curve are obtained and the results applied to a particular case. For certain values of a constant the results are in good agreement but for smaller ones, the results are far from correct.

H. M. B.

See also Abstracts 63, 108, 128, 202, 366, 367, 467, 468.

GRAVITATION.

88. Bruns' Terms. R. Schwinner. *Gerlands Beitr. z. Geophys.* 42. 4. pp. 447-449, 1934.—It is shown that some confusion has arisen in applying Bruns' terms for the different spheroids, and this has led to errors in gravity reductions. [See Abstract 1549 (1932).]

W. A. R.

89. Inequalities of Loading of Earth's Crust. J. de G. Hunter. *Observatory*, 57. pp. 293-299, Oct., 1934.—The isostatic geoid is shown to differ markedly from the geoid derived from observations of the vertical, with particular reference to India. The author gives his reason for complete disagreement with Bowie's conclusions [see Abstract 1835 (1934)]. In particular he does not think it possible to deduce the geoid from surface features. The amount of over- and under-compensation attains the equivalent of a thickness of 800 ft. of average surface rock density. It is suggested that this figure is related to crustal strength. The improvement of knowledge of the geoid must still depend on further observation; some recent progress is outlined.

T. L. M.

HYDRODYNAMICS AND AERODYNAMICS.

90. Air Flow past a Heated Sphere. I. Hartmann. *Frank. Inst.*, J. 218. pp. 593-612, Nov., 1934.—The forced flow of air around a sphere

heated internally is investigated experimentally in a wind tunnel. The results show that within the range of Reynolds number (100,000–170,000) investigated, the flow round the sphere is governed by the properties of a lamina within the boundary layer, approximately 0.75 of the boundary layer thickness away from the solid surface. The distance of this lamina varies slightly with change of Reynolds number. Its position depends slightly on the temperature of the sphere and on the turbulence of the approaching flow. J. S. G. T.

91. Lagrange's Ballistic Problem: the First Median Zone. C. Platrier. *Comptes Rendus*, 199. pp. 770–772, Oct. 22, 1934.—The paper arises from Love's treatment of the problem [see Abstract 1483 (1922)]. Using the notation of that treatment, Love determined the Z function for $n = 5$. The author shows how the same conclusions may be reached for any integral value of n . T. L. M.

92. Flow in Curved Tubes. M. Adler. *Zeits. f. angew. Math. u. Mechanik*, 14. pp. 257–275, Oct., 1934.—The resistance law obtained by integration of the Navier-Stokes equation of motion is applicable only to very small Reynolds numbers. For larger Reynolds numbers an analysis was made on the basis of the boundary-layer theory of Prandtl. This solution gave a law of resistance which closely fitted the experimental results. Both

laws were found to depend on the parameter $\text{Re} \left(\frac{a}{R} \right)^{\frac{1}{2}}$ where Re is the Reynolds number, a the radius of the tube, and R its radius of curvature. Experiments investigating the resistance and the velocity distributions both below the critical velocity and in the region of turbulence are described. W. A. R.

93. Turbulence in Liquid Motion. C. Ferrari. *Accad. Lincei, Atti*, 20. pp. 100–104, Aug., 1934.—Mathematically deduces Kármán's laws and other propositions. A. D.

94. Theory of Non-Newtonian Liquids. M. Reiner. *Physics*, 5. pp. 321–341, Nov., 1934.—Mainly mathematical. Hohenemser and Prager's general treatment of fluid flow, in which the "rheological equation of state" for a material is completely expressed by a relation between the tangential components at any point of the stress, p_t , and the strain, e_t , and their time-derivatives, is applied to the case of a material having a non-linear law of flow; for stationary flow the relation is shown to be of the general form $e_t = f(p_t)$. This is expanded as a Taylor's series,

$$e_t = \sum_{n=1}^{n=\infty} \frac{1}{n!} \cdot \frac{df^{(n)}\theta}{dp_t^n} (p_t - \theta)^n,$$

which is applied to a parallel detailed analysis of the Hagen-Poiseuille (capillary tube) and of the Margules-Couette (rotating cylinder) viscometers. Systematic distinctions are drawn between the behaviour of a Newtonian liquid, a non-Newtonian liquid and a plastic solid stressed beyond its yield-point ("Bingham body") in the two type-experiments; "wall-effects" are considered due to wall-films of different composition from the bulk material. Non-Newtonian liquids are all dispersion systems and their rheological equation of state cannot be expressed as simple power series relating simple functions of p_t and e_t , since e_t is still finite at infinite p_t . For such liquids a relation is derived between their fluidities ϕ_0 and ϕ_∞ under shearing stresses $p_t = 0$ and $p_t = \infty$ respectively. A comparison of this with Einstein's equation for the viscosity of suspensions

suggests that their non-Newtonian behaviour is due to the interference of suspended particles with the mobility of the surrounding medium. Such interference may arise in various ways, *e.g.*, (a) competition between orientation and Brownian movement, (b) elastic deformation under shearing stress, (c) thread deformation, (d) adsorption, (e) "steric immobilisation" (structural viscosity); these, finally are considered as they affect (a) variation of ϕ_{rel} with temperature, (b) reversibility, or absence of a hysteresis loop, (c) existence of a lower limit to non-Newtonian behaviour.

L. V. C.

95. Propagation of a Solitary Wave in a Reduced Channel of Trapezoidal Section. Hégly. *Comptes Rendus*, 199. pp. 826-828, Oct. 29, 1934.—The propagation of a solitary wave in a model consisting of a lock connecting two reaches, is investigated experimentally, after the manner of the experimental work of Russell.

J. S. G. T.

See also Abstracts 30, 129.

KINETIC THEORY OF MATTER.

96. Brownian Motion of an Ellipsoid. Dielectric Dispersion for Ellipsoidal Molecules. F. Perrin. *J. de Physique et le Radium*, 5. pp. 497-511, Oct., 1934.—The theory of the Brownian motion of translation and of rotation, which has hitherto been confined to the case of spherical particles is extended to the case of any ellipsoidal particle. Thus the theory may be applied to the liquid molecules themselves, and to large dissolved molecules which are often very lengthy or much flattened. The principal object of the discussion is the study of the Brownian motion of rotation of an ellipsoid, free or submitted to an alternating directing field, with a view to extending Debye's theory of dielectric dispersion to the case of almost any molecules.

J. J. S.

97. Action of Magnetic Field on Brownian Movement. J. Métadier. *Comptes Rendus*, 199. pp. 1196-1197, Nov. 26, 1934.—No effect was produced on the Brownian movement of particles, whether ferro-, para-, or non-magnetic, by a magnetic field $\gtrsim 20,000$ gauss (the highest available).

C. A. S.

See also Abstracts 71, 94, 136, 266, 373.

LENGTH (STANDARDS, MEASUREMENTS, APPARATUS).

***98. Daily Measurements of Length by Optical Means.** T. Eversmann. *Zeits. f. Instrumentenk.* 54. pp. 350-365, Oct., 1934.—Reference is made first to conclusions drawn by earlier writers when using these methods. The theory of the method of triangulation and the procedure adopted for measurements of length are set out and the accuracy attainable in the results. Examination is next made of measurements of length by (1) the distant rod according to Reichenbach's method, and (2) the double image distance measurer. The mean error of the final point for a rectilinear equal-sided polygonal track is examined in detail. In conclusion, it is shown that the instruments used must be independent of temperature for use on different days while refraction also causes errors on account of temperature and density differences.

R. S. R.

MASS (STANDARDS, MEASUREMENTS, APPARATUS).

***99. Weighing Machines.** W. Lawton. *Junior Inst. Eng.*, J. 45. pp. 73-88, Nov., 1934.—A brief survey of the chief fundamental points

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in the design of the following types of weighing appliances : ordinary beam, Roberval beam, Beranger beam, Phanzeder beam, pendulum indicator, pendulum cam indicator, Avery cross-strap device, spring balance and steelyards. The paper is introduced by a short historical section. P. H. B.

MATHEMATICAL METHODS, THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

100. Problems of Propagation. M. Picone. *Accad. d'Italia, Mem.* 5. 14. pp. 715-749, 1934.—The author obtains formulæ for the effective solution of problems of propagation in space. He finds new conditions of compatibility, which must give rise to further research. There is also an extended use of Green's theorem, and numerical computations for propagation in a stratum of indefinite extent. Particular cases lead to classical theorems. The paper deals with (1) introductory matter, (2) conditions necessary for the existence of new theorems of unicity; (3) propagation in limited strata, (4) propagation in strata of infinite extent. A. D.

101. Mixed Problems in Heterogeneous Space. Heat Equation to n Dimensions. H. Müntz. *Comptes Rendus*, 199. pp. 821-824, Oct. 29, 1934.—The general equation of heat is taken and used to obtain mathematically a solution of the problem of Laplace for this equation in the form of a function when the initial values of the function are known for any point in space. The methods given earlier by the author and Levi for the ordinary case of homogeneous space can be developed in this way for non-stationary points and for variable time. R. S. R.

102. Experimental Probability. A. L. Clark. *Canad. J. of Research*, 11. pp. 658-664, Nov., 1934.—The work described in this paper is a continuation of that published previously [see Abstract 5168 (1933)]. The observations have now been carried to 250,000. The results are in substantial agreement with those already published. The theoretical probability is 0.3554 ± 0.0005 , and the new experimental value is 0.35553 . The value of π is not changed by the later results. The numbers of sequences of different lengths have been recorded and compared with the calculated values. The agreement here is not very good. AUTHOR.

103. Mathematical Basis and Development of a Probability Calculation with Finite Samples. H. Blume. *Zeits. f. Physik*, 92. 3-4. pp. 232-252, Nov. 12, 1934.—The problem is first set out on which the structure, not previously developed, of a probability calculation of finite samples arises. This structure presupposes the provision of a definition for the idea of finite samples and the derivation of its mathematical properties, and from this the definition and the operations of mixing and separation arise. Then for all subsequent basic circumstances that are connected with classes of finite samples it is demonstrated first for the separate case of alternate samples. The generalisation of these results to an m -times combination of any samples requires detailed calculations. This is undertaken and the importance of the first fundamental law for finite samples is shown whilst the new probability calculation supplies a solution of the problem of irregularities. R. S. R.

104. Empirical Error-Curve. A. A. Nijland. *K. Akad. Amsterdam, Proc.* 37. 8. pp. 472-477, 1934. *In German*.—Tests of the Bessel error-curve are made with new material, both astronomical and industrial, and its accuracy discussed. Some theoretical difficulties are discussed. G. C. McV.

105. Points Connected by a Linear Relation. Beryl M. Dent. *Phys. Soc., Proc.* 47. pp. 92-106; *Disc.*, 106-108, Jan., 1935.—The problem of drawing the best straight line through a set of observed points is solved by a method shorter than those previously published. It is essential for the complete solution of the problem to obtain the most probable value of the ratio of the precision constants of the two observed sets of quantities and a new method is given for finding this ratio. Expressions for the errors in the position and inclination of the line are derived and a numerical example is added. AUTHOR.

106. Special Case in the Determination of Probable Errors. J. C. P. Miller. *Roy. Astron. Soc., M.N.* 94. pp. 860-866, Oct., 1934. *Supplement*.—In determining lunar diurnal variations in geophysical elements, such as barometric pressure or the magnetic field, it is convenient first to obtain the solar diurnal harmonic components of the variation from groups of days each corresponding to a particular age of the moon. The resulting values of the amplitude and phase of any component may be represented by a set of vectors each of which corresponds to a group of days. These components include a solar part, which is taken to be the same in amplitude and phase in all groups, a true lunar variation and a part of accidental origin. In this paper it is shown how the magnitude of the accidental part of the component variation may be calculated. When this is done the mean error of the lunar diurnal variation itself can be inferred. J. E. K.

***107. Use of the Planimeter as an Integrator.** E. J. Nyström. *Soc. Scien. Fennica, Comm. Phys. Math.* 7. 10. [25 pp.], 1934. *In German*.—The general purpose of the planimeter is to determine the value of the function $I = \int_{x_0}^{x_1} f(x) dx$. An apparatus which determines this value is called an integrator and that which shows the integral curve is called an integraph. The theory of the planimeter, its method of use and the development of the curve are set out. Direct integration with a linear planimeter for a special system of coordinates, integration with a polar planimeter and the use of its curve as a line of coordinates, and the radial planimeter are described. Finally a comparison is made of the different types of instruments. R. S. R.

See also Abstracts 487, 495.

MECHANICS, CLASSICAL.

108. Analogy of a Statical Problem of a Slightly Bent Elastic Rod to a Simple Case of a Forced Vibration. M. T. Huber. *Acad. Polonaise Sci. et Lettres, Bull.* 5-7A. pp. 212-216, May-July, 1934. *In German*.—The variation of the position of a bent rod in terms of the distance " x " from a fixed point when held by a constant force is found to be represented by an equation analogous to that of a forced oscillation in which the distance " x " is substituted for the time " t ." H. M. B.

109. Virial Theorem for Non-Holonomic Systems. R. J. Seeger. *Washington Acad. Sci., J.* 24. pp. 461-464, Nov. 15, 1934.—A new mathematical form of the virial theorem holding for both holonomic and non-holonomic systems is derived. J. S. G. T.

See also Abstracts 91, 118, 412,

MECHANICS, QUANTUM.

110. Electron in a Homogeneous Magnetic Field According to Dirac's Theory. M. v. Laue. *Preuss. Akad. Wiss. Berlin, Ber.* 18. pp. 305-319, 1934.—According to Dirac's theory the magnetic moment of an electron wave in a homogeneous magnetic field exhibits a precession about the field-direction, of frequency $\frac{|\epsilon| H}{\mu c}$, referred to the "proper time," if the electron is in a quantised state and has no motion in the direction of the field. If such a motion does occur then there becomes added to the precessional part of the motion also a part, constant in time, perpendicular to the field. But if an electron wave enters from outside into the region of the field, its advent does not, indeed, lead to a quantised state but nevertheless the same result holds for the magnetic moment. This result agrees with the experiment of Rupp and Szilard on the influence of a parallel magnetic field on an electron ray. [See also Abstract 2049 (1931).] H. L. B.

111. Quantised Motion under Two Centres of Force. P. Dass. *Indian Phys. Math. J.* 5. pp. 45-51, Oct., 1934.—The wave mechanics of the motion of an electron in the field of two nuclei of unequal charges is studied by an extension of the method used by Hylleraas for the case when the nuclear charges are equal. The eigenenergies are obtained as the roots of a determinantal equation. The analysis applies strictly only when the internuclear distance R is relatively large (first few electronic states), but even for small R values the resulting formula is consistent with established theoretical results. W. S. S.

112. Electromagnetic Fields in the Quantum Theory. L. Goldstein. *J. de Physique et le Radium*, 5. pp. 545-552, Oct., 1934.—This paper, initiating a study of electromagnetic fields, deals with static fields of H-type atoms to a non-relativistic approximation, and neglecting electron spin. The electrostatic potentials and electric fields associated with discrete states are obtained in finite form; the vector potential and magnetic field associated with the levels ($l \geq 1, m \neq 0$) can be obtained only as an infinite series of terms, which, for the vector potential, are products of Legendre polynomials and complex functions of the distance from the origin to the point at which the vector potential is evaluated. The scalar potentials and electric fields of the levels ($n, l \geq 1, m \neq 0$) assume a special form for relatively small distances from the origin and in the neighbourhood of the magnetic axis. N. M. B.

113. Waves, Spin, and Integers. E. Sevin. *Comptes Rendus*, 199. pp. 937-939, Nov. 5, 1934.—By an extension of considerations already announced [see Abstract 4874 (1934)], it is shown that the energies relative to the trajectories of a particle, as previously defined, agree precisely with those which, in contemporary theory, characterise fine-structure. From the variation of the number of collisions with the structure wave of a particle in the course of a revolution a numerical selection rule is obtained for stable orbits and fine-structure components. A simple numerical relation is found between the angular velocity of the proton and the classical radius of the electron, and, taking account of expressions for the radius of the trajectories of the proton and electron, the mass ratio is given in terms of the fine-structure constant. N. M. B.

RELATIVITY AND ETHER.

114. Energy Tensor of a Continuous Medium. J. L. Synge. *Roy. Soc. Canada, Trans.* 28. Sect. 3. pp. 127-171, May, 1934.—The theory of the energy tensor of a continuous medium in special and in general relativity is developed with particular emphasis on logical sequence. All dynamical effects are reduced to collisions between particles and between photons for media which are incapable of tension. For media which are capable of tension it must be assumed in addition that particles can act on one another without coming in contact, through elementary impulses, projectiles passing from one particle to the other with the velocity of light. The conservation law for momentum in a collision is precisely defined and is used to build up an expression for the energy tensor of a disordered system of particles which is then proved to satisfy the usual differential equations of conservation. An invariant definition of a perfect fluid is given as well as precise definitions of the terms "mean motion" and "mean proper density" of a fluid. G. C. McV.

115. Spinors. O. Veblen. *Science*, 80. pp. 415-419, Nov. 9, 1934. *Paper read before the Phil. Soc., Washington, March, 1934, 4th Joseph Henry Lecture.*—The spinor theory grew out of the attempt to reconcile wave-mechanics with the relativity theory. A new kind of physical quantity, the spinor, had to be introduced, which is connected with the spinning electron. Spinors are best understood by considering first vectors, then tensors, gauge frames, gauge transformations, and gauge invariance. A spinor is a physical object with components which are not ordinary numbers but complex numbers of the form $a + ib$. The number of components is a power of four. A linear transformation of the components is called a spin transformation. A set of components is fixed only after the coordinate system, the gauge-frame and the spin-frame are fixed. It is not the components of the spinors themselves which are interpreted in terms of physical measurements but certain combinations of these components with their complex conjugates. The general theory of spinors is the theory of all possible quantities of a certain sort. The theory of the electron is the theory of certain particular spinors which describe this electron.

H. L. B.

116. Stationary Inertial Fields in Accelerated Systems of Reference. W. Glaser. *Zeits. f. Physik*, 91. 3-4. pp. 169-183, Oct. 2, 1934.—The only coordinate system of the most general kind in which the inertial forces that occur are independent of the time is the Cartesian coordinate system which rotates with constant angular velocity about an axis while advancing with uniform acceleration along this axis. The constant inertial force, the Coriolis force and the centrifugal force are therefore the only "apparent forces" independent of the time; the "Einstein box" and the "rotating disc" are therefore, in accordance with the Principle of Equivalence, the only systems in which the inertial fields that present themselves correspond to gravitational fields. If the inertial force is not also to depend on the velocity, the system of reference moving with constant angular acceleration alone remains. Since the formula for the inertial forces has the form of the Lorentz force in the electromagnetic field, a derivation of the Lagrange force is obtainable from this force. It is also found that the only transformation, that contains the time and that transforms the Cartesian line-element into one of stationary form is that corresponding to a uniform rotation about an axis.

H. L. B.

117. Space and Time in Arbitrarily Moving Systems. W. Glaser. *Zeits. f. Physik*, 92. 1-2. pp. 64-75, Nov. 2, 1934.—Transformation formulæ are set up between infinitesimal space and time differences in an inertial system and in a system of reference moving arbitrarily with respect to it. On the basis of the conditions of integrability of these equations the question is discussed as to what moving systems allow one to speak of space and time at all, and also what systems have a geometrical space structure. It is shown that only the line-element can be resolved into space and time in systems in uniform motion. This proves, in particular, that it is wrong to state that the geometry on a rotating disc is non-Euclidean. H. L. B.

118. Relativisation of Classical Mechanics. Part I. A. Lev-ašov. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 4. pp. 31-35, Oct. 11, 1934. *In German*.—In his general theory of relativity, Einstein has postulated the metrical structure of physical space but has not considered the physically important problem of space arithmetic. The relativity theory is now investigated from a more general process in which the arithmetic of space is considered, and the metrical character derived as a consequence of a particular physical law. The necessary postulates are stated, the equations of the geodetic lines of the defined space determined, and the specific character of space from the standpoint of Newtonian mechanics discussed. The inner structure of space is derived from the properties of the curvature magnitudes. As an application of his theory the author discusses the perihelion motion of Mercury. H. H. Ho.

119. Principle of Least Action in Milne's Kinematical Relativity. A. G. Walker. *Roy. Soc., Proc.* 147A. pp. 478-490, Dec. 1, 1934.—It is shown that the equations of motion of free particles in Milne's kinematical system [see Abstract 1347 (1933)] can be expressed under the form of the principle of least action, and the general form of the appropriate weighting factor is found. Particular forms of the general solution are discussed, and it is finally shown that Milne's kinematical system cannot be equivalent to any kinematical system of general relativity. AUTHOR.

120. Unified Field Theory. Part II. T. Awano. *Phys. Math. Soc., Japan, Proc.* 16. pp. 414-422, Nov., 1934. *In English*.—The author claims that it is possible to construct a unified field theory of gravitation and electromagnetism by using a "conformal" metric, $ds^2 = \lambda g_{\mu\nu} dx^\mu dx^\nu$, where λ gives the electromagnetic and the $g_{\mu\nu}$, the gravitational parts of the field. He discusses his proposal in the light of the Weyl gauge-invariance theory. [For Part I see Abstract 3552 (1934).] G. C. McV.

121. Quantisation of the New Field Equations. Part I. M. Born and L. Infeld. *Roy. Soc., Proc.* 147A. pp. 522-546, Dec. 1, 1934.—The new field theory [see Abstract 1875 (1934)] uses the primary field vectors E, B and derives secondary field vectors D, H by differentiating the Lagrangian L (E, B), with respect to E, B. If the invariant form be given up (*i.e.*, the four-dimensional tensor notation) other pairs of primary variables can be introduced, altogether in four ways: E, B—D, H—E, H—D, B; and in each case there exists an action function, from which the complementary pair can be derived by differentiation. The most important case is the last one; for the action function U (D, B) is just the energy-density. Using this representation it is possible to formulate the quantum laws of the field. The components of D, B have to be considered

as q -numbers, being functions of x, y, z, t and satisfying the same commutation laws as have been used by Heisenberg and Pauli. The field equations can be written without any space or time derivatives, only by means of commutators connecting the field vectors with the total energy and the total momentum. The relativistic invariance of the commutation laws which is not immediately evident can be proved by a direct application of the method of infinitesimal transformation. These results show that the new field equations allow a coherent unitarian quantum theory of matter and field to be formulated.

AUTHORS.

122. Ether Drift. C. V. Drysdale. *Nature*, 134. pp. 796-798, Nov. 24, and pp. 833-835, Dec. 1, 1934.—As *prima facie* case for the existence of an ether, the author takes the repugnance of certain minds for "action at a distance" and also the fact that Maxwell's electromagnetic equations are of such a mathematical form that they can be interpreted as meaning that electromagnetic disturbances are propagated as if they were waves in a medium having certain properties. He then reviews the evidence of experiments of Michelson-Morley type to detect motion through this presumed ether, and concludes that the evidence cannot prove or disprove the existence of the motion. He considers that a first-order effect must be found before the motion can be taken as proven and asserts that a surface polarisation method for light would provide such an effect.

G. C. McV.

See also Abstracts 100, 112.

SOLUTION.

123. Heats of Dilution of Strong Electrolytes. A. L. Robinson and H. S. Frank. *Am. Chem. Soc., J.* 56. pp. 2312-2313, Nov., 1934.—Integral heats of dilution data have been examined to test an extension of a rule proposed by Åkerlöf for activity coefficients of strong electrolytes. The validity of the rule seems to depend upon the temperature. [See Abstracts 3556 and 4450 (1934).]

AUTHORS.

124. Solubility of Hydrogen in Liquid Ammonia at 25, 50, 75 and 100° C. and at Pressures to 1000 Atmospheres. R. Wiebe and T. H. Tremearne. *Am. Chem. Soc., J.* 56. pp. 2357-2360, Nov., 1934.—Full solubility data, in terms of c.c. of gas at N.T.P. per gm. of ammonia, are tabulated at 6 or 7 pressures in the range 50-1000 atmospheres for each temperature. The increase in solubility with temperature and pressure is illustrated by graphs.

N. M. B.

125. Effect of One Salt on the Solubility of Another. Part VI. Solutions of Cobaltammines in Aqueous Lanthanum Thiocyanate. L. O'Neill and J. R. Partington. *Faraday Soc., Trans.* 30. pp. 1134-1144, Dec., 1934.—The solubilities of *iso*-thiocyanato-pentammine-cobalt-nitrate and *iso*-thiocyanato-pentammine-cobalt-iodide have been determined in presence of lanthanum thiocyanate. The simple limiting law of Debye and Hückel (ionic diameter = 0) for activity coefficients does not represent the results, except in the case of very dilute solutions, for the salts examined. The first Debye-Hückel approximation (diameter of ion finite) does not provide an adequate explanation of the experimental results, but gives a positive correction in the right direction. The La Mer equation for unsymmetrical electrolytes provides an adequate explanation of the experimental data for ionic strengths up to 0.1, when the assumption $a = a_0$ is not made in calculating the ionic diameters. There is reason to

suppose that an extension of the numerical computation to the higher terms of the integral would provide a more satisfactory representation of the data. [For Part V see Abstract 3555 (1934).] AUTHORS.

126. Theory of Supercooled Solid Solutions. S. Konobejewski. *Zeits. f. phys. Chem.* 171. *Abt. A.* 1-2. pp. 25-35, 1934.—A theoretical discussion is given of the conditions of stability of supercooled solid solutions, and of the mechanism of the process of separation into distinct phases, including orientated separation. L. A. W.

127. Intermetallic Compounds Formed in Mercury. A. S. Russell, T. R. Kennedy and R. P. Lawrence. *Chem. Soc., J.* pp. 1750-1754, Dec., 1934.—Intermetallic compounds Zn_7Mn , Zn_4Mn , Zn_3Mn , $Zn_{4.2}Co$, Zn_3Co , $ZnCo_4$, $Zn_{4.2}Ni$, Zn_3Ni , $ZnNi$, $AlFe$, Al_4Fe_3 , $AlFe_3$, Sn_3Mn , Sn_2Mn , $SnMn$, $SnMn_2$, Sn_2Co , and $SnCo_2$ have been found by the mercury method and analysed without their removal from the mercury. The formulæ in italics represent new compounds. The agreement of these empirical formulæ with those obtained by thermal and X-ray methods in the six systems is satisfactory. It is concluded that the compounds investigated by the mercury method are the same as those investigated and characterised by workers with physical methods. AUTHORS.

See also Abstracts 68, 78, 82, 83, 228, 388.

SURFACE TENSION AND COHESION.

128. Adhesion of Small Particles. B. Derjaguin. *Kolloid Zeits.* 69. pp. 155-164, Nov., 1934.—In this paper, an adhesion theory for solid bodies is developed which takes into account molecular attraction forces and includes cases (1) where the bodies are not deformed and (2) where a deformed contact surface arises. For case (1) a quite general formula is derived according to which the adhesive force of convex bodies is proportional to the work of separation per surface unit. Consideration of the influence of the phase (3) which fills the space between the bodies leads to repulsion phenomena which are closely bound up with lyosorption. In case (2) a correction to the Hertz formula is derived which is equivalent to the presence of an adhesion force independent of the contact surface. Further the influence of a fourth phase is considered which in the vicinity of the points of contact of two bodies is regarded as of a capillary character. The mutual effects of these four circumstances are considered in detail.

H. H. Ho.

129. Stationary Waves in Liquid Jets. J. Satterly and J. A. McPherson. *Roy. Soc. Canada, Trans.* 28. Sect. 3. pp. 177-183, May, 1934.—Stationary waves are often set up in steady jets impinging on a liquid or a solid obstacle. Relations between the velocity of the jet, the diameter, the wave-lengths and the surface tension have been formulated. In this paper vertical water jets striking a convex glass surface and vertical mercury jets striking a horizontal mercury surface have been studied. The relation between the wave-length and the diameter of the jet has been verified, but unknown factors seem to enter into the relation involving the surface tension. The work will be continued until the reasons for the variations in the surface tensions are discovered. AUTHORS.

130. Surface Tension and Tangential Pressure in Relation to Osmotic Pressure. G. Bakker. *Zeits. f. phys. Chem.* 171. *Abt. A.* 1-2. pp. 49-69, 1934.—If H and ζ are respectively the surface tension and the

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thickness of the capillary layer, and p_N and p_T the pressures in the direction perpendicular to the surface and in the direction parallel to the surface of the capillary layer, $H = (p_N - p_T)\zeta$. For the capillary layer of a pure liquid in contact with its saturated vapour, the tangential pressure p_N (vapour pressure) may be calculated, provided that an equation of state for the liquid is known. The well-known investigations of Pockels, Langmuir and Adam refer to a case in which a barrier floating on a liquid surface is subjected on the one face to a water surface covered with a monomolecular layer, while the other face is exposed to the action (pressure) of the uncovered water surface. If the magnitudes for the covered water are indicated by accented symbols, the force measured in the experiments referred to is given by $p^1_T \zeta^1 - p_T \zeta$. With a gas-like oil film this expression leads to the formula found by Adam and Jessop for the osmotic pressure.

T. H. P.

131. Surface Tension and Rate of Rise of Aqueous Solutions in Porous Bodies. Paulette Berthier. *Comptes Rendus*, 199. pp. 1221-1223, Nov. 26, 1934.—According to Guye's theory [see Abstract 1708 (1930)] the rate of rise is independent of surface tension, but it has been stated elsewhere that surface tension is of importance. This point is investigated by measuring the rate of rise in filter paper of pure water and of saturated solutions of menthol (surface tension 61 dynes/cm.), camphor (51.45 dynes/cm.), iso-amyl alcohol (27.5 dynes/cm.) and of saponin, 5gm. per litre (43.5 dynes/cm.), these solutions having sensibly the same density and viscosity as water. Within the accuracy of measurement the rate of rise was found to be independent of surface tension.

P. H. B.

132. Quantitative Correlation of Interfacial Free Surface Energies. F. E. and L. S. Bartell. *Am. Chem. Soc., J.* 56. pp. 2205-2210, Nov., 1934.—A linear equation is established which connects the cosine of the interfacial angle and the adhesion tension of any given liquid for a series of solids. The relationship between such an equation for water and that for any organic liquid is derived and equations are developed connecting the interfacial angle and the air contact angle. Useful results are obtained when " $K\gamma_3$ " is substituted for the cosine of the interfacial angle and given values beyond the limits $+1$ to -1 . Equations are presented by which after only one accurate determination of the adhesion tension or of the contact angle of a given liquid for a given solid, the adhesion tension of this solid for water or for any other liquid whose interfacial tension against water is known may be calculated.

P. H. B.

***133. Undeformable Acetocellulose Films.** A. Charriou and (Miss) S. Valette. *Comptes Rendus*, 199. pp. 1039-1041, Nov. 12, 1934.—A cellulose film shrinks after being soaked in water and dried. This is a very definite disadvantage in precision aerial cartography, and the present authors briefly describe results of experiments undertaken to produce an aceto-cellulose film which is not deformed by water. It is shown that an acetocellulose film containing 59.5 % acetic acid with 25 % triphenylphosphate gives only 0.055 % deformation 90 days after soaking, no deformation being observed after treating this film for 15 min. in boiling water, heating for 4 hrs. at 100°, or giving 12 successive soakings and dryings. The deformation of aceto-cellulose films decreases with increase of acetic acid and the amount of the plastifier is very important. [See also Abstract 3166 (1934)].

R. C. F.

134. Structure of Surface Films. Part XXI. Surface Potentials of Dibasic Esters, Alcohols, Aldoximes and Ketones. N. K. Adam, J. F. Danielli and J. B. Harding. *Roy. Soc., Proc.* 147A. pp. 491-499, Dec. 1, 1934.—Surface potential measurements on spread films of molecules with two ethyl ester groups, at opposite ends of a long chain, show a constant value of μ , i.e., inappreciable interaction between the dipoles of the end groups, so long as the molecules remain flat and the films are gaseous. μ is much larger for these groups when the molecules lie flat than when standing on end. With alcohols, methyl ketones, and aldoximes, μ does not change much during transition from the expanded state to the condensed, indicating that the orientation of the end groups to the surface remains nearly unchanged. μ is usually smaller for a given end group attached to aliphatic chains than to a sterol skeleton. [For Part XX see Abstract 73 (1934).] AUTHORS.

135. Flow Potentials for Capillaries in Paraffin Wax. H. R. Kruyt and R. Ruysen. *K. Akad. Amsterdam, Proc.* 37. 8. pp. 498-505, 1934. *In French.*—The difference of potential generated in the flow of various electrolytes through a capillary in paraffin wax, was measured for different concentrations of the electrolytes. The curves of flow potential against concentration were established for KCl, BaCl₂, AlCl₃ and Th(NO₃)₄ and show general similarity to corresponding curves obtained with glass capillaries. The differences are attributable to the chemical properties of glass. W. S. S.

See also Abstract 72.

VACUA, HIGH.

See Abstracts 2, 428.

VISCOSITY, FRICTION AND LUBRICATION.

136. Mechanism of Viscosity of Liquids. A. Goldhammer. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 3. pp. 487-490, Sept. 1, 1934. *In German.*—Jager, who introduced in 1903 the concept of an "ideal liquid" and applied the gas laws and Maxwell viscosity coefficient, obtained a formula which gave inaccurate viscosity-temperature relationships. The present author has derived another formula by introducing the formula of Batschinski and certain assumptions into the original formula of Jager. It is pointed out, however, that the formula needs experimental verification. J. K.

137. Viscosity of Liquid Phosphorus. S. Dobiński. *Acad. Polonaise Sci. et Lettres, Bull.* 3-4A. pp. 103-114, March-April, 1934. *In German.*—The viscosity of liquid phosphorus from 17.5° to 80° C. was measured *in vacuo* with an Ostwald-type viscometer. The value at the melting point (44.1° C.) is 0.0171 poises compared with the predicted figure of 0.0114. The relation between log. (viscosity) and 1/T (absolute) which, according to Andrade, should be linear, is only so above 49° C. This implies association below 49° C., which is critical also for such properties as the dielectric constant, polarisation and refraction; association equilibrium is only slowly attained and rapid heating or cooling hence gives variable results. When rapidly supercooled, liquid phosphorus becomes turbid, subsequently clearing; the phenomena are ascribed to a separation into two phases, of unequal density, one of which is unstable. L. V. C.

See also Abstract 380.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***138. Converting Straight to Broken Transit.** C. C. Smith. *Roy. Astron. Soc. Canada, J. 28. Sect. 3. pp. 345-346, Oct., 1934.*—Describes the changes made on a straight tube Cooke transit, to convert it into the broken type, the precautions against flexure, advantages gained, and use made of the instrument. T. L. M.

***139. Influence of a Deformed Axial Cap on Observations with a Transit Instrument.** P. Labitzke. *Zeits. f. Instrumentenk. 54. pp. 396-402, Nov., 1934.*—The right ascension of 500 fundamental stars has been observed at Königsberg to determine errors of $\Delta\alpha_0$ in the new catalogue. An insignificant deformation of the axial cap even for a relatively short transit instrument can falsify the errors systematically. With known right ascension the instrument was used for individual star transits for elimination of the collimator error and, with correct time, for readings in both positions of the levels a value of the inclination was found. This is true only if the axial caps are cylindrical. The method used to overcome this error is discussed and results are tabulated to show the success obtained in the measurements. R. S. R.

See also Abstracts 156, 181, 266.

COMETS AND METEORS.

140. Interpretation of Cometary Phenomena. Part II. K. Wurm. *Zeits. f. Astrophysik, 9. pp. 62-78, Sept. 18, 1934.*—The author continues the application of the theory already developed [see Abstract 3575 (1934)]. The high outward velocities of the molecules streaming from the nucleus are accounted for by the large energy of translation liberated in optical dissociation phenomena. The effects are examined for the principal component molecules. The author is able to draw up diagrams of the orbits of molecules streaming outwards in various directions; according to the length of the life of the molecule various envelopes and a tail are produced, and these are shown to agree well with observation. Extensions and variations of the Bessel-Bredichin theory of cometary forms are developed. T. L. M.

See also Abstract 142.

COSMOGONY.

See Abstracts 146, 163.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

141. Roche's Model. P. ten Bruggencate. *Zeits. f. Astrophysik, 8. pp. 344-357, Aug. 28, 1934.*—Roche's model plays an important part as a limiting case in a number of problems of cosmogony. The present paper discusses some gaps in the existing theory. The connection between instability and the relative masses of the disturbed and disturbing bodies is investigated for the pure tidal problem. In the more complex case of tidal action by a disturbing body on a rotating Roche model, a method is

developed for delimiting the region of instability for any given rotational velocity. For the pure tidal problem this, of course, reduces to the well known Roche's limit.

T. L. M.

142. Determination of Geocentric Distance for Parabolic Orbit.

R. H. Sciobereti. *Nat. Acad. Sci., Proc.* 20. pp. 539-541, Oct., 1934.—Covers the same ground as Abstract 2371 (1934)].

T. L. M.

See also Abstract 150.

LATITUDE AND LONGITUDE.

143. Latitude Redetermination and Systematic Errors. **J. Weir.**

Roy. Astron. Soc. Canada, J. 28. pp. 347-356, Oct., 1934.—An extensive series of observations with the zenith telescope, by the author and a number of students, permits sources of systematic error to be examined. The individual error may be higher than when all observations are made by one observer, but tests can be applied for differences between one observer and another. Several sources of error are discussed separately. The yearly means also show a quasi-periodic variation which is not traced to any observational cause. The period is about six years, the variation several times the probable error of any year's series.

T. L. M.

NEBULÆ.

144. Proper Motions of 33 Planetary Nebulæ. **C. M. Anderson, Jr.**

Lick Observat., Bull. No. 462. pp. 21-32, 1934.—A comparison of 88 pairs of plates of nebulae (larger than 13" dia.) taken with the 36-in Crossley reflector at epochs beginning 1899 and 1928 respectively. The intervals between the pairs are, in the mean, 31.2, 23.9 and 15.9 yr. The average relative proper motion in a great circle (regardless of sign) is $0''.0117$ and the average probable error of a proper motion is $\pm 0''.0033$. The mean parallax computed (from the τ and ν components) is $+0''.00070$ agreeing with van Maanen's (from 23 nebulae). Low galactic latitude nebulae are (in the mean) more distant than high ones, and small nebulae than large. The mean absolute photographic magnitude of the central stars is $+0.9$, and the mean linear diameter of the nebulae is 0.55 parsec.

A. S. D. M.

145. Visual Cosmic Nebular Clouds. **F. Becker.**

Astrophysik, 9. pp. 160-162, Nov. 1, 1934.—An independent examination is made to check a part of Hagen's list of results for cosmic nebular clouds. Good general agreement is found on all essential points. A chart of Hagen's results is compared with a new chart obtained by the author.

H. L. B.

146. Structural Features of the Metagalaxy. **H. Shapley.**

Roy. Astron. Soc., M. N. 94. pp. 791-816, Oct., 1934. *Supplement.*—The extent of the Milky Way is derived from cluster-type Cepheids, the number of which in high latitudes has been greatly increased by the Harvard programme. Allowing for absorption and remaining uncertainties as to their absolute magnitude, the thickness of the Milky Way is not less than 25 kiloparsecs for this type of star. Its extent in the anti-centre quadrant is at least 10 kiloparsecs (at long. 150°). The study of the Large Magellanic Cloud has yielded over 500 new variables, mainly Cepheids, whose properties agree in all details with the classical Cepheids; the frequency of periods is studied in detail. The period-luminosity curve is strengthened by the additional data, especially at the high luminosity

end. No disturbing effect of light absorption is traced. The spectra of 3000 stars in the Cloud have been classified, chiefly super-giants. 75 B-type stars are the brightest known, absolute magnitude between -6 and -8 . Microdensitometer tracings and outlying clusters show the diameter of the Cloud to be at least 12° . The diameter of the Small Cloud is increased from 3.6° to 8° , of the Andromeda nebula to 4.5° , with a width of nearly 4° . The faint parts of the object are much more nearly spherical than the bright parts. For other bright objects the diameters now recorded are 5 times those hitherto published in the case of spheroidal systems, 2.3 times for spirals. The disparity between the dimensions of these two types of system largely disappears. The Harvard census of galaxies brighter than magnitude 18 has given 125,000 new galaxies in one-third of the sky. Several surveys are now proceeding. There is no convincing evidence of a true dependence of the number of galaxies on our galactic latitude. The search for possible density gradient of galaxies reveals very extended concentrations with many thousand members. Luminosity curves have been determined for over 20 groups of galaxies.

T. L. M.

147. Evolution of Spiral Nebulæ. P. Wellmann. *Zeits. f. Astrophysik*, 9. pp. 47-61, Sept. 18, 1934.—This investigation starts from the rate of decrease of mass in a spiral nebula due to radiation. The change of mass is shown to be sufficient to alter elliptic orbits to close spiral curves. The author assumes the accuracy of Jeans' equilibrium figures in the general case, and shows that such an instability leads to a model which reproduces the density distribution and evolution of observed spirals. Hubble's classification is used and the age of the furthest developed spiral assumed of the order of 10^{10} years. The expansion of the spirals and their rotation as unitary bodies are also accounted for.

T. L. M.

PLANETS.

148. Constitution of Inner Planets. H. Jeffreys. *Roy. Astron. Soc., M. N.* 94. pp. 823-824, Oct., 1934. *Supplement*.—The density of the inner planets increases with the diameter. It is not an effect of compression, and appears to be due to variations in the size of the metallic core. The bearing of this on the argument for a catastrophic origin of the planets is considered.

T. L. M.

149. Internal Constitution of the Great Planets. R. Wildt. *Göttingen Nachrichten*, 1. 5. *Fachgruppe* 2. pp. 67-78, 1934.—The density of the great planets cannot be accounted for on a single formal hypothesis. And the attempt of Jeffreys to distinguish three layers is shown to conflict with the properties of a gaseous atmosphere. The author therefore adduces the investigation by F. Simon of the change of melting point of gases under high pressure. He concludes that the free atmosphere of Jupiter and Saturn cannot exceed 1 % of their radius and that at least 97 % of the volume consists of a non-gaseous aggregation. His model otherwise resembles that of Jeffreys. The relative abundance of the principal components is studied and compared with that of the sun. The results are generally satisfactory; in particular the ratio of H to metals is not greater; in fact some loss of the permanent gases is suggested even in these planets.

T. L. M.

150. Distribution of Planetary Perihelia. J. Mascart. *Comptes Rendus*, 199. pp. 772-774, Oct. 22, 1934.—The author continues his

examination of the motion of asteroids referred to the position of Jupiter, according to the methods of the restricted problem [see Abstract 3584 (1934)] and derives a method for finding the trajectory of the planet about its mean position. The application of the method limits the position of perihelion for planets near a lacuna. The lacuna $3/2$ is examined; of 15 planets, 14 confirm the theory; the exception has a very low eccentricity. T. L. M.

151. Polarisation of Asteroids. B. Lyot. *Comptes Rendus*, 199. pp. 774-777, Oct. 22, 1934.—The image of the planet is formed on a small aperture. A birefringent prism placed behind the aperture forms two images side by side on a photographic plate. A series of exposures are made by moving the plate at right angles to the line of the images. The order of the images is reversed between each pair of exposures by rotating the plane of polarisation. If the images are not equally bright, the proportion of polarised light is easily found, given the contrast factor of the plate. Tests on stars and in the laboratory indicate a high order of precision, of the order of $1/1000$. Observations of Vesta show polarisation less than for the moon, the angle of inversion greater, plane always perpendicular to the plane passing through the sun; the points lie satisfactorily on a curve between those for the moon and for chalk. T. L. M.

152. Formation of Ring Mountains. I. Ruud. *Zeits. f. Astrophysik*, 8. pp. 295-343, Aug. 28, 1934.—The author's view is that the ring mountains characteristic of the moon are due to circular rupturing of an upper plastic layer of the lunar surface under powerful tension forces due to its contraction. A large number of experiments on plastic membranes subjected to tension in two directions is described. The redistribution of material due to the formation of a gap in the plastic layer approximately satisfies the condition of isostasy and Schroeter's rule is thus approximately correct. The differences of albedo which exist on the moon would also occur on this theory; in particular bright radial streaks such as are observed on the moon are also produced by the author's experiments. Several special types of lunar formation are also discussed in some detail; the author concludes with a discussion of analogies between the moon and the earth. T. L. M.

See also Abstracts 106, 141.

STARS.

153. Atmospheric Extinction Factor in Photoelectric Photometry. W. M. Smart. *Roy. Astron. Soc., M.N.* 94. pp. 839-846, Oct., 1934. *Supplement*.—Of the methods described in a previous paper [see Abstract 1009 (1934)] for determining " f ," the atmospheric extinction factor, the one which has found the most application depends on the principle that the photometer performs constantly from night to night provided the photo-cell voltage remains constant. A new method based on the same principle is now described, the fundamental equation of which is: $\log(T_0)_1 \cos z_1 - \log(T_0)_2 \cos z_2 = \cos z_1 \log T_1 - \cos z_2 \log T_2$ where z_1 and z_2 refer to the zenith distances of two stars, T_1 and T_2 the corresponding time measurements and $(T_0)_1$ and $(T_0)_2$ the time measurements corrected for atmospheric effects. From several such equations set up at definite time intervals the constants $(T_0)_1$ and $(T_0)_2$ can be determined and hence the value of f at any particular time. The method is illustrated from observations of the pair of A α stars, α Cor. Bor. and β Urs. Maj. on four nights of

good visibility and from observations of the pair of Ao stars 12² Can. Ven. and o Her. on three nights of poor visibility. J. E. K.

154. Differential Rotation of Star Streams. Renée Canavaggia and Marie-Louise Fribourg. *Comptes Rendus*, 199. pp. 777-778, Oct. 22, 1934.—If a star stream presents a differential rotation effect, and is moving in a circular path, the stream will disintegrate in less than one rotation of the galactic system, and will thus be in comparison an ephemeral formation. The authors have therefore examined the Ursa Major, Taurus, and Scorpio-Centaurus groups, and find a differential rotation with constants differing greatly from those of the principal rotation. They suggest that the difficulty may be avoided if the streams prove to have elongated orbits. T. L. M.

155. Equivalent-Width Measurement as Method for Line Profile Investigation. M. Minnaert. *Observatory*, 57. pp. 328-342, Nov., 1934.—The author points out that the *total absorptions* of faint lines are well-defined photometric data (even with low dispersion) since the amount of the total radiation, which has disappeared in the line, cannot be influenced. He takes this total absorption as the "equivalent width," and its unit as $10^{-6}\lambda$. He considers the errors of measurement, the theoretical significance of resonance, and the physical causes (Doppler, damping, Stark, coupling and hyperfine structure effects) in stellar atmospheres by which the absorption coefficient is made to extend on both sides of a line. A diagram is given of equivalent widths of Fraunhofer lines as a function of the concentration. He discusses the significance of equivalent widths for non-resonance lines, and the method of determining curves of growth. There is a satisfactory agreement with laboratory results. Results are summarised in a table, and the method is applied to interstellar Ca.

A. S. D. M.

156. Atmospheric Absorption in Stellar Spectra and Atmospheric Ozone. D. Barbier, D. Chalonge and E. Vassy. *Rev. d'Optique*, 13. pp. 199-213, June-July, 1934.—Spectra of the same star at different zenith distances are taken on the same plate, and calibrated by the spectrum of a hydrogen tube [see Abstract 2490 (1934)]. Comparative study gives the atmospheric absorption; the stellar spectrum is then completely freed of this effect; results on the continuous absorption at the end of the Balmer series are given. The nocturnal ozone content is derived from the atmospheric absorption in the ultra-violet. There is no evidence of variation as between day and night. The apparatus is an objective prism quartz spectrograph; the arrangements are very fully described. T. L. M.

157. Visual Colour Relations of Stars in Praesepe. K. Graff. *Akad. Wiss. Wien, Ber.* 143. 2a. 7. pp. 425-430, 1934.—A hundred stars of the cluster Praesepe have been visually examined with the author's special wedge calorimeter [see Abstract 774 (1932)]. It is found that those of types F to K show a normal relation of colour to spectrum, but A to F show marked colour excess and also scatter widely about the mean.

M. A. E.

158. Redness of 190 Stars. W. Becker. *Zeits. f. Astrophysik*, 9. pp. 79-109, Nov. 1, 1934.—The redness of 190 bright stars was measured using infra-red plates. The chief conclusions were the following: (1) If the colour-indices for different spectral regions between the violet and blue were comparable, the colour-indices were very small and the star normally coloured. If the star was abnormally coloured, the colour indices for the different spectral regions were widely different. (2) B, K

and M stars were characterised by being whiter in the red-colour-index than in the blue or the infra-red. A, F and G stars showed the opposite tendency. (3) Excess brightness in the red was accompanied by a smaller excess or a deficit in the blue, and conversely. (4) The c-type of line spectrum was accompanied in the continuous spectrum of cB stars (up to B8) by strong reddening in the blue and the red spectral regions; for A and early F stars, by no effect; and for late F stars, by a strong reddening in the blue region. G. C. McV.

159. Physical Interpretation of the Excitation Mechanism of the Emission Lines in the Late Spectral Types. K. Wurm. *Zeits. f. Astrophysik*, 9. pp. 156-159, Nov. 1, 1934.—In the spectra of the stars of the classes M, S, N, R Balmer lines often occur in emission with intensities that are abnormal. These stars are nearly all variable stars. The long-period variables are super-giants of extremely small density and consist almost entirely of hydrogen. The anomalous intensities of the Balmer lines may be accounted for if it may be assumed that their excitation proceeds for the main part by way of the hydrogen molecule. Observations are made of the way in which this may occur as a result of recombination of the molecules from the atomic constituents and of a selective property of atomic hydrogen in recombination processes. H. L. B.

160. Stellar Limb Darkening and Internal Temperature. G. Tiercy. *Arch. des Sciences*, 16. pp. 69-79, March-April, 1934.—The author's previous studies of radiative equilibrium have led to a solution of the problem of temperature distribution between the inner part of the star (where the polytropic solution is satisfactory) and the surface. This leads to a law of limb darkening which is further developed here. The relation between this law and the distribution of internal temperature is now developed in a form which allows of the successive approximations to the problem being suitably derived. The variable is the darkening coefficient of the visual disc. T. L. M.

161. Constitution of White Dwarf Stars. T. Araki. *Zeits. f. Astrophysik*, 8. pp. 358-369, Aug. 28, 1934.—It is shown that the polytropic index, $n = 1.5$, of the fundamental equation for the case of the white dwarfs, can be altered by adopting a generalisation of the standard model of Milne. The author's basic assumption is that $1 - \hbar\epsilon/4\pi Gc$ is proportional to $\rho^{-\sigma}$. The mathematical theory is fully developed. The case $\sigma = 1$ is discussed numerically, with a comparison of the results with observation. T. L. M.

162. Internal Constitution of Perfect Gas Stars. P. ten Bruggencate. *Zeits. f. Astrophysik*, 9. pp. 110-122, Nov. 1, 1934.—The investigation was undertaken in order to test E. A. Milne's hypothesis that a star of mass and luminosity similar to those of observed stars and which consists of perfect gas throughout should be of radius 1 parsec, with central density of 10^{-25} gm./cm³ and central temperature of order 1° Abs. Following a method of transformation of the equations of the problem, due to Rosseland, and by numerical integrations, it is shown that Milne's hypothesis is false for stars of mass and luminosity comparable with those of the sun. Only if the mass is very great compared with that of the sun, will the star take up the configuration envisaged by Milne. G. C. McV.

163. Absorbing Matter in the Universe. B. Jung. *Zeits. f. Astrophysik*, 9. pp. 1-46, Sept. 18, 1934.—The object is to investigate the possibility of permanent absorbing matter in interstellar space. The ratio of radiation pressure to gravitation under the influence of all stars

within 15 parsecs of the sun is first investigated for particles of differing size. Under diameter 0.01μ and above 1μ the effect of radiation pressure is small. Next assuming the whole of a galactic absorption of 0.3 magnitude per kiloparsec to be due to one kind of absorbing material, three cases are discussed: gaseous, and solid with or without colour effect. In all cases the necessary density is less than that permissible; no conclusion is possible as to the nature of the matter. The third problem is whether gaseous matter can escape: this is examined for the galactic system, where escape is possible until the system attains a potential of 41 volts, thereafter no longer possible; and for a globular cluster, M 13, where it is not possible for the potential to rise so high and escape is always possible. On suitable assumptions, free path and frequency of collision are computed for ions and electrons; even in long periods of time, the proper motion of individual particles is likely to remain low. The formula of Baade and Pauli suggests that interstellar gases are mainly not subject to strong radiation pressure. The gravitational attraction to the centre of the galactic system is also investigated.

T. L. M.

164. Distribution of Interstellar Scattering Matter as Shown by Colours of Early-Type Stars. S. L. Thorndike. *Lick Observat., Bull.* No. 461. pp. 9-19, 1934.—Spectra of 62 stars of types Oe5 to B2 have been examined for colour excess. The differences observed may be interpreted as due to scattering of light produced by irregular clouds in the galaxy, in part also to intrinsic dissimilarities in the stars.

M. A. E.

165. Galactic Star Clusters. Part I. NGC 2632 (Præsepe). W. E. Bernheimer and J. P. Reimer. *Akad. Wiss. Wien, Ber.* 143. 2a. 7. pp. 453-487, 1934.—Methods have been given independently by N. Tamm and G. A. Tichov for determining photographic colour equivalents by means of a single photograph. Tamm's method of inserting an opaque circular screen in front of the objective divides the extra-focal stellar image, produced in the visual plane of a refractor, corrected for photographic rays and registered on orthochromatic plates, into a blue and a yellow annular image. By measuring the dimensions of these rings the colour equivalent of the star is obtained. 82 stars of Præsepe are measured in this way. The Hertzsprung-Russell diagram is discussed in its relationship to hydrogen absorption and colour index. It is considered established beyond doubt that Præsepe contains absolutely brighter and at the same time whiter dwarfs than occur normally in the dwarf series of the galactic system; by analogy with super-giants they should be called super-dwarfs. [See following Abstract.]

H. L. B.

166. Galactic Star Clusters. Part II. Luminosity Effect and Colour Equivalents of Stars of the Pleiades. W. E. Bernheimer. *Zeits. f. Astrophysik*, 9. pp. 123-133, Nov. 1, 1934.—Additional support is adduced for the view that the Pleiades contain stars which are whiter than field stars. "White" F5 dwarfs have greater absolute luminosity than normal F5 dwarfs of the Pleiades and have greater intensity of H_γ . Similarly white stars between B5 and A2 are brighter absolutely than the normal white stars and have less intense H_γ lines. It is shown that the B-stars of the Pleiades resolve into two groups of absolute luminosity with appreciable differences in H_γ -intensity and colour. In studying the colour excesses in the Pleiades and also in other galactic nebular clusters the luminosity effect plays an important part. [See preceding and following Abstracts.]

H. L. B.

167. Galactic Star Clusters. Part III. Interpretation of Anomalies in the Hertzsprung-Russell Diagram for Præsepe.

W. E. Bernheimer. *Zeits. f. Astrophysik*, 9. pp. 134-155, Nov. 1, 1934.—Reasons are given for the anomalies described in the two previous communications [see preceding Abstract]. There are giants and dwarfs in the sense of Malmquist. This division may be proved from H_γ -intensities obtained in Saltsjöbaden and from colour equivalents estimated in Vienna and at Mount Wilson. The A-dwarfs themselves are to be divided into two groups, group "A" being characterised by average luminosity and average H_γ -intensity, group "B" by lesser luminosity and lesser H_γ -intensity. At the same time it may be shown that there is a colour-equivalent effect, group "A" being white and group "B" yellow. H. L. B.

168. Photometric Study of Brightness of Cluster M 13.

C. Sălceanu and C. Popovici. *Comptes Rendus*, 199. pp. 1020-1022, Nov. 12, 1934.—The method used is that proposed by C. Fabry in 1910. The instrument is the Prin equatorial of the Bucarest Observatory; the comparison stars are photographed through a circular diaphragm of 2 mm. dia., the cluster through one of 14 mm. (corresponding to 8' in the sky); a yellow screen (GG 11 Zeiss) is for photovisual magnitude; the plates are panchromatic Agfa superpan; the images have been measured in a Moll microphotometer. Six measures of photographic magnitude were obtained between 31 August and 7 October and the cluster magnitude deduced; the gross magnitude varies between 6.65 and 6.74 (with mean 6.70) thus agreeing well with the Vyssotsky-Williams result of 6.7. This value may be interpreted as a compensation of absorption with the luminosity of the atmosphere, and an attempt was made on 7 Oct. to estimate the latter, giving $6^m.59$, the difference of $0^m.11$ being the error due to the dissymmetry of the two diaphragms employed. The photovisual magnitude obtained is 5.13, or when corrected for atmospheric absorption $5^m.37$, which gives colour index of value 1.46 and 1.37 corresponding to type K, not agreeing with the Vyssotsky-Williams result of $0^m.68$ —a discordance explained by the differences of screens and plates employed.

A. S. D. M.

169. Spectroscopic Binary Orbits by Mass-Luminosity Relation.

G. Durand. *Comptes Rendus*, 199. pp. 1099-1101, Nov. 19, 1934.—Minimum masses and semi-major axes are supposed known, along with total visual magnitude, parallax, and the spectrum type of both components. The mass of each component is assumed a function of its absolute visual magnitude corrected by the term U for spectrum type. The ratio of these functions is then that of the known minimum masses. The magnitudes are written $M + x$, $M + y$, where M is the combined absolute visual magnitude; we have thus one equation connecting x and y , and they are also simply related to one another. From the resulting values of x and y the masses are found, hence the inclination and then the major axis. Tables can be used to simplify the calculation, and also to verify that a solution is possible. The errors due to parallax appear more serious than those due to uncertainty of spectrum type. The method has been tested on stars also observed as eclipsing variables.

T. L. M.

170. Spectrum of Nova Pictoris in 1934.

H. S. Jones. *Roy. Astron. Soc., M.N.* 94. pp. 816-823, Oct., 1934. *Supplement*.—The wave-lengths of the centres of the bands are tabulated. Notes are given on the more important identifications, variations from previous years, etc. The measurement of band widths has been possible; the relative

velocities indicated show no appreciable change since 1926. The slow decline in the brightness of the star makes it possible to hope that further transitions will be observed; at present the spectrum resembles that of Wolf-Rayet stars only superficially and is more comparable with certain planetary nebulae. T. L. M.

171. Light Variation of V22 = SV Andromedæ. J. van der Bilt. *Roy. Astron. Soc., M.N.* 94. pp. 846–856, Oct., 1934. *Supplement.*—The long-period variable SV Andromeda has been continuously and systematically observed since 1912, with the exception of a small interval, by numerous astronomers. The observations are critically examined and collected together in graphical and tabular form. The mean period is found to be $315^d.8$. The maximum brightness is found to vary with a mean period of about 930 days. The minima of this second period appear to exhibit a third periodicity of approximately 5400 days. It is remarkable that the same complex type of light variation here derived for a long-period variable is also exhibited by RV Tau which has a period of 39 days and has been assigned to a different class of variables. J. E. K.

172. Complex Light Curves. J. van der Bilt. *Roy. Astron. Soc., M.N.* 94. pp. 857–860, Oct., 1934. *Supplement.*—A number of variable stars are known to show a light-curve composed of a short and a long wave. In two recent publications by Zessewitsch and by O'Connell [see Abstract 5222 (1933)] it is shown that on plotting the two periods of a number of such stars against each other a smooth curve results. A similar plot is now carried out for a number of stars having complex light curves formed of up to three component periods. A systematic relation is likewise obtained but the author goes on to point out the inconclusive nature of such relations and questions whether the setting up of the relations is justified. It is pointed out that, when the ratio of the periods is between 2 and 1, it becomes almost impossible to analyse the complex curve on account of the complication introduced by the different amplitudes and phases of the components. The purpose of the paper is to raise a warning against the drawing of premature conclusions from curves of the type found by Zessewitsch and O'Connell. J. E. K.

173. P Cygni. C. S. Beals. *Observatory*, 57. pp. 319–327, Nov., 1934.—The star's history is given from discovery on August 8th, 1600, when it was of the 3rd magnitude. It has disappeared and reappeared at various times, sometimes reaching to nearly 3m, but since 1715 it has remained stationary at about 5.1m. A description is given of the general character of the spectrum lines; it is classified by Plaskett and Pearce as BIQK, and the author suggests that the character of the lines is due to a continuous radial ejection of atoms, resulting in a discrete shell or series of successive shells. A diagram indicates the absorption lines as due to the passage of the star's rays through the shell and the emission lines to the parts of the shell outside the star's apparent disc. Gerasimovič's temperature of 5700° C. is too low. By Greenwich temperature measurements and Zanstra's method a temperature of nearly $30,000^{\circ}$ C. is derived. No satisfactory solution of the line profiles is found, and it is suggested that a study be made of the related groups of novæ and Wolf-Rayet stars. A good Bibliography is given. A. S. D. M.

174. Reality of the Correlation Observed between the Eccentricities and Periods of Double Stars. D. Barbier. *Comptes Rendus*, 199. pp. 930–932, Nov. 5, 1934.—An investigation is made into the claim that there is an appreciably linear relationship between the eccentricities

and the logarithms of the periods of double stars (both visual and spectroscopic binaries). It has been suggested that this relationship may only be apparent, that is to say, produced by the solution of the binaries which it is possible to study. The increase in the number of known orbits should diminish the effects of selection. The author applies this criterion to visual and spectroscopic binaries separately and comes to the conclusion three hypotheses are possible: (1) there is actually a slight correlation between the eccentricities and the periods; (2) there is no correlation, but visual and spectroscopic binaries form two groups having different mean eccentricities; (3) there is no correlation, all binaries having the same mean eccentricity which would be very nearly equal to 0.5. The author favours the last hypothesis. H. L. B.

See also Abstracts 8, 139, 145, 146, 147, 342, 412.

SUN.

175. Polarisation of Solar Corona. V. Fesenkov. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 3. pp. 447-449, Aug. 21, 1934. *In French.*—The polarisation of the corona can conveniently be determined by photographing the eclipsed sun in light reflected from a black mirror. The amount and plane of polarisation can be found if three polarising mirrors are used, oriented 60° from one another, each serving a separate camera. The necessary formulæ are developed. T. L. M.

176. Variations in Form of Solar Corona. H. Ludendorff. *Preuss. Akad. Wiss. Berlin, Ber.* 16. pp. 200-220, 1934.—It has been shown by several writers, including the author [see Abstract 432 (1929)] that the form of the corona is correlated with the number of sunspots, being almost circular at sunspot maximum and greatly more developed at the equator than at the poles at sunspot minimum. These changes in form are expressed numerically by the author, his figures representing the relative flattening at the poles; and he once more discusses the question whether coronal changes follow the 11-year period only, or whether they are also influenced by the short-lived irregular changes which often occur in general solar activity. His data seem to show that maximum flattening tends to occur shortly before minimum spot activity, and minimum flattening before maximum spot activity. But further research indicates the questionable conclusion that the flattening at any given date may be correlated with the frequency of sunspots 2 or 3 months earlier. The 1918 corona had a maximum form on the west, and a minimum form on the east side of the sun, and this agreed with an excess of western spots, which was marked at the time, but it had also been evident for some months previously. Bernheimer and Bergstrand both considered that the corona shows only the long-period change, but he finds their arguments unconvincing. The correlation of corona form with prominences, which was proved by W. Lockyer qualitatively by comparing his 3 types of corona with the heliographic latitudes of prominence zones, is now proved quantitatively by comparing the degree of flattening with prominence areas, and (apart from the connection of some large prominences with detailed coronal structure near them) the correlation is much closer than with spots. Doubtless all three phenomena are affected by changing conditions on the sun. And it is most probable that the corona undergoes rapid changes as well as slow, although this is not yet certainly proved.

M. A. E.

177. Instructions for Obtaining Solar Radiation Intensity Measurements. H. H. Kimball. *Union Géodésique et Géophysique Internationale, Procès-Verbaux*, 2. pp. 51-63, 1933. In English.—Three classes of measurements are recognised (a) the intensity in the total solar spectrum received directly from the sun on unit area of a surface normal to the incident rays, (b) the intensity on a unit horizontal surface received from the sun and from the sky, (c) the intensity in particular parts of the spectrum either for direct rays as in (a) or for direct and diffuse as in (b). The types of pyrheliometer in use or available for use are referred to and the method of standardisation of the same indicated. Records are obtained either by automatically recording instruments or by eye readings. Records of radiation obtained by those methods are discussed. By considering the effects of dust, water vapour and the mass of air passed through, the author is able to tabulate atmospheric transmission and depletion both for the whole energy and for different regions in the spectrum. From the (b) method he has also been able to find a relation between the automatically recorded duration of sunshine and the total daily radiation receipt. But for a solution of problems connected with solar radiation measurement more accurate determinations received in all parts of the world are considered essential. A. E. M. G.

178. Density of Optical Diffusion, Characterising the Atmosphere as a Turbid Medium. F. Lindholm. *Union Géodésique et Géophysique Internationale, Procès-Verbaux*, 2. pp. 91-96, 1933.—To investigate the characteristic values of direct insolation for a definite place, it is necessary to find the diminution of intensities of radiations of different wave-lengths by absorption in the atmosphere. This diminution arises from the diffusion of the radiations, the latter due mainly to two causes, (1) constant, (2) variable, the latter arising from the content and size of material particles in the air. An equation is given showing the relation between the radiation arriving at the surface of the earth and that arriving at the outside of the atmosphere. From this, a quantity termed the "optical density" is deduced. Tables computed from observations are given for this optical density Δ , at different levels. These show that this quantity increases as height above sea level decreases. The variation of Δ , with variation of wave-length is referred to and the results obtained at Davos by the aid of filters and a photoelectric cell tabulated. The author concludes that the optical density as defined in the paper provides a factor characterising the atmosphere as a dispersive system where the selective absorption of the solvent is entirely eliminated. A. E. M. G.

179. General Sunshine Values for the British Isles, 1909-1933. D. S. Hancock. *Roy. Meteorolog. Soc., J.* 61. pp. 45-50; *Disc.*, 50-52, *Jan.*, 1935.—Four sets of tables are compiled for (a) England and Wales, (b) Scotland, (c) Ireland, (d) The British Isles. These give the general values of sunshine for each month of every year as a percentage of the whole period, together with quarterly and five yearly values and the highest and lowest value for each month with the year of occurrence. The whole period is also compared with the period 1881-1915. The author discusses the results dealing first with outstanding years in the period, and then with the five year periods. From a comparison of the period 1909-1933 with 1881-1915, it appears that 1881-1915 was more sunny than the succeeding period. A. E. M. G.

180. Distribution of Energy in the Ultra-Violet Solar Spectrum as Inferred from the Photochemical Theory of the Ozone Equilibrium in the Earth's Atmosphere. D. Eropkin. *Phil. Mag.* 18. pp. 838-841, Nov., 1934.—Assuming the mean annual value of the ozone constant for each geographical latitude Chapman's equations for the ozone variation and Dobson's data for the mean ozone content in different latitudes leads to a height of 50 km. for the ozone layer. Recent data of Götz, Meetham and Dobson suggested greater heights. From the photochemical theory the sun's ultra-violet spectrum corresponds to Planck's curve if the mean height is 20 km. and that the sun's spectrum must be five times richer in ultra-violet energy if the mean height is 50 km. General physical considerations lead to a height of 20 km. and it was hoped to test the values in the U.S.S.R. stratosphere flight. R. S. R.

***181. Heliographic Positions and Components of Velocities Involved in Solar Spectroscopy.** R. E. DeLury. *Roy. Astron. Soc., Canada, J.* 28. pp. 385-390, Nov., 1934.—A compilation of formulæ description of tables prepared to simplify application; a graduated sphere and coordinate frame for reading the heliographic coordinates and auxiliary angles is described. The component of velocity of the earth's orbital revolution is also found with the assistance of a rotating position circle device. The method is in regular use at Dominion Observatory, Ottawa. T. L. M.

ZODIACAL LIGHT AND GEGENSCHIEIN.

182. Zodiacal Band. R. B. Bousfield. *Roy. Astron. Soc., M.N.* 94. pp. 824-838, Oct., 1934. *Supplement.*—The Zodiacal cones have been observed in Queensland since 1931, their shape and position charted by a specially devised framework, and intensity measured with two types of lumeter. The succession of phases of the cones has proved to be the same each year and is fully described and illustrated. In 1931 July the full Zodiacal band was first observed. It was carefully charted on many nights and shows slight fluctuations about the line of the ecliptic. A series of photometric observations is appended. The Gegenschein is rarely seen. There is no clear indication of a supposed lunar effect on the zodiacal light. An attempt to test the effect of a solar eclipse was inconclusive. The light of the band has sometimes appeared to undulate; this does not seem to be a physiological effect as the same phenomenon could not be reproduced with the Milky Way. T. L. M.

GEOPHYSICS.

GEOPHYSICS, APPLIED.

183. Geopotential. V. Bjerknes. *Union Géodésique et Géophysique Internationale, Procès-Verbaux*, 2. pp. 7-13, 1933.—This discussion is divided into four sections. The first deals with the system of coordinates employed. The possibility of applying the method to obtain topographic charts traced for suitably chosen values of potential difference, and the use to which such charts may be put is considered in section two. The author devotes the third section to a discussion of the terminology to be used, and concludes that the best method is to follow the example of Lagrange and employ generalised coordinates. The next point, viz., that of logical names for the unit of potential, forms the subject matter of the last section. The term favoured by the author is that of dynamic metre. A. E. M. G.

HYDROSPHERE, PHYSICS OF THE.

184. Density Current in the Ocean. T. Nomitsu. *Kyoto Coll. Sci., Mem.* 16. pp. 261-274, July, and pp. 383-396, Nov. 1933. *In English*.—The writer defines a "density current" as such a current as would be produced by a local difference in density alone and not attended by any sloping of the sea surface. He first finds the density current in a uniform solenoidal field and shows that the current produced by the sudden generation of a local difference in density will attain its steady value in only a few hours, or days at most. But the density of the actual water in the real sea does not change sensibly during a few days and shows only the yearly variation, so that the density current may be considered as always having a steady value corresponding to the gradient of density from time to time. Next the "convection current" composed of a density and a slope current influenced by land is discussed. The convection current of Ekman's type corresponds to the case of a long straight coast perpendicular to the density gradient. The writer corrects some errors in Ekman's result, and discusses several other cases of convection current. First the "density current" in an open boundless sea with uniform solenoidal field and then the "convection current" influenced by land are discussed under the condition of "no bottom-friction." The writer thus finds that Ekman's current-diagram put forward by him as the fundamental convection current, represents nothing but the current in an enclosed sea with no bottom-friction and that all the other current diagrams given by Ekman for convection currents are more or less erroneous. As the source of these errors the writer enumerates four weak points in Ekman's theory. K. Hidaka's paper on the non-stationary convection current [see Abstract 3999 (1933)] also contains similar weakness. [See following Abstract.] AUTHOR.

185. Density Current in the Ocean. T. Nomitsu and T. Takegami. *Kyoto Coll. Sci., Mem.* 16. pp. 397-408, Nov., 1933. *In English*.—The density current in a uniform solenoidal field is here treated again on the assumption most probable for a real sea, that there acts a finite bottom-friction depending on the slip velocity. The distribution of the steady current and the mode of development of the current are found to be very different according to the magnitude of the density-gradient and the

turbulence of the sea. For a large density-gradient and a little turbulence, the current approaches that seen in the case of "no bottom-current"; and for a small density-gradient and a large viscosity it approaches that seen in the case of "no bottom-friction." [See preceding Abstract.] **AUTHORS.**

186. Theory of the Rising Stage of Drift Current in the Ocean.

Part II. Case of No Bottom-Friction. T. Nomitsu. *Kyoto Coll. Sci., Mem.* 16. pp. 275-287, July, 1933. *In English.*—Practical measurements of current in real seas, especially in shallow waters, as well as in rivers, generally show that it is more appropriate in reality to consider some "slip velocity" at the bottom than to assume "no bottom-current."

Moreover, there are many phenomena, such as long waves or seiche motion, which may be practically explained even by the hydrodynamics of an ideal fluid that can slide freely on solid boundaries. The writer treats here again [see Abstract 3428 (1933)] the rising stage of drift current on the supposition that the water is uniformly viscous but there is no friction for slipping on the bottom. Comparing the results obtained thus with those in the previous case of "no bottom-current," it is deduced that: (1) For a very deep sea, the current coincides exactly with that in the previous case. (2) The shallower the sea, the stronger is the current and the larger becomes the angle of deflection from the direction of the wind, just contrary to the previous case. (3) The velocity of the current oscillates around the steady value with a period of 12 pendulum hours as before, but it does not attain a definite value even when $t = \infty$, and the hodograph has an asymptotic circle whose radius is inversely proportional to the depth of the sea. (4) The time required for the current to attain a quasi-steady state is about one-third the time required for it to become steady in the previous case. The real sea of course must lie between the two extreme cases of "no bottom-velocity" and "no bottom-friction." [See following Abstract.]

AUTHOR.

187. Theory of the Rising Stage of Drift Current in the Ocean.

Part III. Case of Finite Bottom-Friction Depending on Slip Velocity. T. Nomitsu and T. Takegami. *Kyoto Coll. Sci., Mem.* 16.

pp. 309-331, Sept., 1933. *In English.*—Having found that in a shallow sea there would be too grave a difference between the currents in the two cases already dealt with [see preceding Abstract], the writers treat the problem again on the assumption most probable for a real sea, that there can exist a bottom-velocity V_H and a bottom-friction $R_b = f\rho V_H^2$ or $f'\rho V_H$ according to the strength of V_H . The results show that: (1) For a deep sea, the current is approximately equal to those in the two cases of "no bottom-current" and "no bottom-friction." (2) For a shallow sea, the mode of generation and distribution of the current will be very different according to the wind velocity and the turbulence of the sea. For a strong wind the current approaches to that in the case of "no bottom-current," and for a weak wind to that in the case of "no bottom-friction." (3) At a given latitude, the greater the wind velocity Q or the smaller the viscosity of water, the greater is the ratio of the bottom velocity V_H to Q ; but this ratio can not exceed a limited value, even if the wind velocity becomes infinity. (4) The greater the depth of the sea, the smaller is the ratio V_H/Q , and it becomes zero for an infinitely deep sea.

AUTHORS.

188. Development of the Slope Current and Barometric Current in the Ocean. Part II. Different Bottom-Conditions Assumed.

T. Nomitsu and T. Takegami. *Kyoto Coll. Sci., Mem.* 16. pp. 333-351, Sept., 1933. *In English.*—For the same reasons as those given in the writers'

second and third reports upon the drift current in the ocean, the slope current is here treated again on two different assumptions with regard to the bottom condition: (1) that there is "no bottom-friction" and (2) that there acts a finite resistance depending on the bottom-velocity. In the case of "no bottom-friction," the whole water from surface to bottom must have the same velocity and it coincides with the motion of the surface water of an infinitely deep ocean with "no bottom-current." In the case of a "finite bottom-friction" due to the bottom velocity, the mode of generation and distribution of the current will differ very much according to the magnitude of the surface slope and the viscosity of water. For a large slope and a small viscosity, the current approaches that seen in the case of "no bottom-current"; and for a small slope and a large viscosity it approaches that seen in the case of "no bottom-friction." Further, the current possesses a character similar in many other respects to that of the drift current found in the case of similar bottom-conditions, explained in the previous papers. [See Abstract 3429 (1933)]. To put it briefly, the effect of a bottom-friction is to add to the current found in the case of "no-bottom friction" such a "no bottom-friction" drift current as would be produced by a wind traction equal to the given bottom-friction and acting there.

AUTHORS.

See also Abstract 142.

LAND, PHYSICS OF THE.

See. Abstracts 152, 221.

METEOROLOGY.

189. Heat Radiation in the Polar Night at Jan Mayen. H. Tollner. *Akad. Wiss. Wien, Ber.* 143. 2a. 7. pp. 417-423, 1934.—Measurements were made of the outgoing radiation with an Ångström Tulipan instrument. Calibration of it later with an Ångström compensated pyrgeometer showed good agreement. Mean monthly values of the outgoing radiation are quoted but diurnal values could not be obtained. No connection could be established with wind direction or speed. There is a big variation with cloud form and amount. A chart shows mean values with different cloud types and amounts. The outgoing radiation, Q , is connected with the cloud amount, B , in tenths, for any height, by the relation $Q = 0.08 - 3/5 (B/100)$, and for an increase in B of $1/10$ the value of Q decreases by $0.006 \text{ cal./cm.}^2 \text{ min.}$ The values are less than those derived from Ångström's formula and by other observers in these high latitudes and this is ascribed to the greater amount of water vapour in the atmosphere at Jan Mayen. R. S. R.

190. Entropy as a Meteorological Element. N. Shaw. *Union Géodésique et Géophysique Internationale, Procès-Verbaux*, 2. pp. 41-44, 1933. In English.—The atmosphere at any time may be separated into physically different layers by surfaces of equal entropy and so the entropy of the air is an element in the definition of its position. Change of entropy qualifies air for a new position. Also on an isentropic surface an isothermal is also an isobaric line. Under special conditions isentropic surfaces may be easily constructed. In order to obtain an isentropic surface for a particular time, there are required (1) the original data of observation of pressure and (2) some indication of the lapse rate of temperature. Such maps may aid in an understanding of the general circulation of the atmosphere. For

between the equatorial air above 4 km. and the polar air near the surface exists a discontinuity marked by an isentropic surface in which a corrugation means a cyclonic depression. The problem of the shape and behaviour of these corrugations is that which the author puts forward for future solution. A. E. M. G.

191. Upper Atmosphere. C. K. M. Douglas. *Roy. Meteorolog. Soc.*, J. 61. pp. 53-69; *Disc.*, 69-70, Jan., 1935.—The first part of the paper consists mainly of detail, and the latter part of a discussion of general principles, dealing more especially with the structure of depressions and anticyclones. The paper is in five sections: (1) It is shown that the changes of temperature of a given moving air mass at fixed levels between 2 and 5 km. are often slow, but that subsidence of initially cold air may cause a rise of temperature of the order of 10° F. in 24 hours in certain cases. (2) It is shown that the ascending air over a rain area is normally warmer than the adjacent air at the 4 km. level. Some details are given. (3) The variations of the height of the tropopause are discussed. It is thought that the air masses just below and above the tropopause move (slowly) up or down together. (4) The rotary aspects of depressions and anticyclones are considered in relation to convergence and divergence in the horizontal motion. The high-level systems appear first behind the low-level centres and are sheared over them. It is thought that a high-level depression is partly advective in character but also develops over the subsiding cold air, while a high-level anticyclone (or wedge) develops over rising warm air. (5) It is considered that the troposphere is normally the primary theatre of action, but that air movements in the stratosphere play a necessary part in the development of depressions and anticyclones. There is some discussion of surges and of the movements of air from one system to another. AUTHOR.

192. Dust in the Atmosphere. C. S. Durst. *Roy. Meteorolog. Soc.*, J. 61. pp. 81-87; *Disc.*, 87-88, Jan., 1935.—A picture is formed of a dusty atmosphere in which each particle of dust is surrounded by a pocket of air of different temperature and humidity from those of the general air mass. This picture is shown to be corroborated by the rising of haze tops, the air temperature over the Arabian Sea during the S.W. monsoon and the diurnal variation of wind in that region. Some consequences are pointed out, one of which is that there may be a layer of dust high up in the atmosphere. AUTHOR.

193. Drought Years and the Earth's Past. W. Mathesius. *Naturwiss.* 22. pp. 787-792, Nov. 23, 1934.—Summarises the earth's history from the view-point of possible changes in the constitution of the atmosphere and of the varying state and distribution of its water resources. The author contemplates a steady process of desiccation. He considers, however, that drought years can be guarded against by various measures, afforestation, conservation, use of underground supplies, etc. T. L. M.

194. Climate During Abnormal Summers in Europe and Asia. E. E. Jessop. *Roy. Meteorolog. Soc.*, J. 61. pp. 7-40; *Disc.*, 40-43, Jan., 1935.—Four periods of drought, viz., 1921, 1911, 1895, 1893 form the subject matter of this discussion. Maps are drawn giving the pressure and rainfall distribution for each month over the area considered, the rainfall maps showing the actual rainfall as a percentage of the mean for the month. If the classification of droughts in the British Isles be adopted where droughts are divided into those caused by absence (a) of orographical rain, (b) of cyclonic rain, then detailed consideration of the 1921 drought proves

it to belong mainly to the (b) or anticyclonic type. The drought of 1893, though shorter, more closely resembles that of 1921 than the other two. For the present the author considers three types of pressure instead of two as causing drought, (a) a north-eastern extension of the Azores high to the British Isles, (b) anticyclonic conditions over Western Europe linked with high pressure over Siberia, (c) pressure high over north-western Europe. The characteristics of these types are reviewed. Information is not sufficiently complete to warrant the formation of definite conclusions regarding the origin of the droughts. The author concludes by considering the partial dependence of the Indian monsoon rainfall on the pressure distribution over Siberia. A. E. M. G.

195. Interferometer Determination of Wave-Length of the Green Auroral Line. L. Vegard and L. Harang. *Geofysiske Publ.* 11. 1. [17 pp.], 1934. *In English*.—The auroral green line has been measured interferometrically for comparison with a similar measurement of the night-sky green line by Babcock [see Abstract 1791 (1923)]. As a preliminary it was measured from glass-prism spectrograms (result $5577\cdot35\text{\AA}$). A long series of determinations was made with each of two quartz Fabry-Perot étalons, 2·5 and 5·0 mm. thick. The auroral green radiation was isolated by a Wratten filter before passing through the étalon and lens (anastigmat, $f/1\cdot8$, $f = 10\cdot5\text{ cm.}$) to the photographic plate (Agfa isochrom.). The system was mounted in a double-walled heat-insulating box for some exposures and in an electrically controlled thermostat for others. The auroral interferometer pattern was measured against the Ne $\lambda 5852\cdot488$ pattern, photographed on the same plate before and after the auroral exposure, to correct for temperature changes. The 5 mm. étalon yielded the more reliable results, the mean being $5577\cdot3445 \pm 0\cdot0027\text{\AA}$ which is so near Babcock's, $5577\cdot350 \pm 0\cdot005\text{\AA}$, as to establish the identity of the auroral and the night-sky line. Comparison of determinations in directions perpendicular and parallel to the streamers showed that the Doppler effect, if present, cannot exceed $0\cdot006\text{\AA}$. W. J.

196. Emission Spectra of the Night Sky in the Ultra-Violet. J. Dufay. *J. de Physique et le Radium*, 5. pp. 523–526, Oct., 1934.—An examination has been made of a photograph of the zenith obtained with a quartz spectrograph which includes 78 bands or rays of emission of which 45 were below $3900\text{\AA}$. This spectrum differs from those of the polar aurora by (1) the feeble intensity of the negative nitrogen bands, and that, relatively greater, of the bands of the second positive group, and (2) the presence of a much greater number of rays of uncertain or unknown origin. The comparisons already made in the visible spectrum by Cabannes and Dufay with the red spectrum of A, neutral He, and especially the spectrum of unknown cometary nuclei are extended to the ultra-violet region. The continuous spectrum of Fraunhofer rays is much weaker below $3500\text{\AA}$ whilst the bands and rays emitted remain intense up to the limit of atmospheric transparency. They explain the great intensity of the radiation of the night sky in the ultra-violet mentioned at other times by the author. [See Abstract 1790 (1923)]. R. S. R.

197. Ultra-Violet Spectrum of the Night Sky. J. Gauzit. *J. de Physique et le Radium*, 5. pp. 527–532, Oct., 1934.—The extreme ultra-violet of the spectrum of the night sky has been studied from seven photographs obtained with a quartz spectrograph. The observations were made at Montpellier looking to the north. A list is given of all the rays observed, the wave-lengths are compared with those found by Dufay,

Sommer, Cabannes-Dufay and Vegard, their possible identification with the red spectrum of argon and the ultra-violet of parhelium and ortho-helium made, and some which are doubtful are quoted. Absorption by atmospheric ozone is not shown and emission appears to be still appreciable towards 3000 Å and beyond. R. S. R.

198. Luminosity of the Higher Layers of the Atmosphere. J. Cabannes. *Comptes Rendus*, 199. pp. 909-912, Nov. 5, 1934.—The observed spectrum of the night sky [See Abstract 3219 (1934)] is explained by supposing that the primary cause is the production at a high altitude by an external agency (electron bombardment) of a large number of excited nitrogen molecules N_2^* (8.1 volts above normal state) and of ozone molecules, which then descend to lower altitudes. The luminosity of the night sky is regarded as a sort of phosphorescence in the mixture N_2^* , O_3 , O_2 and H_2O . Thus collision of N_2^* and O_3 may cause dissociation of the O_3 to give metastable O_2 ($^1\Sigma$) and O (^1S), which will then emit the observed band $^1\Sigma \rightarrow ^3\Sigma$ and the observed line $^1S \rightarrow ^1D$ (5577 Å) respectively. Collision of O (^1D) with normal H_2O may excite the latter to vibrate and emit the observed band 6324 Å. Finally collision of $O(^1S)$ with N_2 may excite the latter so as again to cause emission of bands as actually found.

L. A. W.

199. Visibility and Atmospheric Suspensoids at Kew Observatory. H. L. Wright. *Roy. Meteorolog. Soc.*, J. 61. pp. 71-77; *Disc.*, 77-80, Jan., 1935.—At Kew Observatory, in the afternoon, the distance of vision if above about 2 km. depends so little on nuclei and humidity that their effect may be neglected. The distance of vision varies inversely as the number of particles raised to a power apparently a little greater than unity. It also depends on some other quantity which is subject to annual variation and it is suggested that this quantity may be the size of the particles. Conditions of mist and fog in the afternoon are associated with high humidity and with high concentrations of particles and nuclei. As each one of these quantities increases so does the density of the fog. The order of importance of these three quantities cannot be assigned at present with any certainty.

AUTHOR.

***200. Radio-Meteorography as Applied to Unmanned Balloons. W. H. Wenstrom.** *Monthly Weather Rev.* 62. pp. 221-226, July, 1934.—Unmanned balloons can be fitted with light apparatus which will transmit the values of pressure, temperature and humidity of the upper air by radio to stations on the earth, and by using directional receivers the position of the balloon, the altitude and the velocity of the wind can be ascertained from the radio signals. The method is of importance upon misty days and for high altitudes.

H. M. B.

See also Abstracts 106, 156, 180.237, 272, 387.

SEISMOLOGY.

201. Hypocentral Depth as a Function of the Epicentral Distance and the Emergence Angle of the P-Wave. P. Caloi. *Ricerca Scientifica*, 2. 3-4. 1934. *Com. Geod. e Geofis.*, Publ. No. 7. [9 pp.], 1934.—The method of calculating the hypocentral depth worked out in a previous note [see Abstract 129 (1934)] is extended, and precautions to be observed in using it are laid down. Three cases, already calculated on other, more laborious methods are worked out, and the results by the new are found to agree with those of the older methods.

W. A. R.

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202. Wave Propagation Parallel to the Plane Surface of an Elastic Solid, with Seismological Applications. S. Higuchi. *Tokyo Univ., Technol. Reports*, 11. 2. pp. 12-20, 1934. *In English*.—It is shown mathematically that, besides the Rayleigh wave, there is also the possibility of the existence of an elastic wave, having horizontal and vertical components of the displacement propagated parallel to the free surface of a semi-infinite elastic solid. The wave is assumed to have the characteristics of one which can penetrate deeply into the interior of the solid. The form of the wave and the ratio of its horizontal and vertical amplitudes are discussed. It is suggested that the investigation may have applications to the classification of the phases of an earthquake wave.

R. S. R.

203. Propagation of Waves along a Surface Stratum of the Earth. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 12. pp. 263-268, Sept., 1934. *In English*.—The propagation of Rayleigh waves along a surface, where the lower layer is highly rigid, is worked out, owing to its importance in relation to the free oscillations of a soil. The waves transmitted are dispersive, and there is little motion in the lower medium, although its character affects the transmission. Also the ratio of horizontal to vertical components of the displacement of a point on the free surface becomes smaller with increasing wave-length.

W. A. R.

204. Reflection and Refraction of Seismic Waves in a Stratified Body. Part II. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 12. pp. 269-276, Sept., 1934. *In English*.—The work of Part I [see Abstract 980 (1933)] is now extended to other special cases ranging from $fH = 1/50$ to 10.

W. A. R.

205. Effect of a Discontinuity Surface upon the Propagation of Elastic Waves. Parts III-V. G. Nishimura and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 12. pp. 277-367, Sept., 1934. *English Abstract*.—Curves are given showing the results when a dilatational wave of the shock-type is incident at the boundary of two solids capable of sliding over each other without friction; when incident on a boundary at which two solids closely adhere, and when there is an intermediate elastic layer, and the solids slide over each other at the boundaries without friction. [For Parts I & II see Abstract 4426 (1933).]

W. A. R.

206. Origin of Earthquakes as Illustrated by their Periodicity. C. Davison. *Geolog. Mag.* 71. pp. 493-500, Nov., 1934.—The important periods are: I, solar, (a) annual, (b) diurnal; II, lunar, (a) 29.6 days, (b) 14.6 days; and III, that of the earth's throb (a) 42 min., that of the return of the wave to its place of origin, and (b) 21 min., that of its reaching the antipodes thereof. As regards I, earthquakes are probably connected with variations of atmospheric pressure, which as a rule have maxima in midwinter, and about midnight; consequently where the epoch of I (a) or (b) occurs at these times the earthquakes are likely to be due to depression of the crust and vice versa. II, If the maximum epoch of II (a) occurs at new moon, or of II(b) at new or full moon the movement is probably one of upheaval, and of depression if (a) occurs at full moon or (b) at first or last quarter. III, if the aftershocks are due to continued exertion of the initial force the maxima should occur at 42 minute intervals from the original shock, i.e. at intervals of $2n \times 21$ min.; if due to reversal of that movement (e.g. settling of uplifted crust) then at intervals of $(2n + 1) \times 21$ min. These conclusions are illustrated from recorded earthquakes, showing

frequent probable differences of origin in neighbouring areas, and reversals of movement. C. A. S.

207. Microseismic Disturbances. A. W. Lee. *Meteorolog. Office, Geophys. Mem. No. 62.* [33 pp.], 1934.—Microseismic records of January, 1930, at 57 observatories have been analysed and compared. The mean amplitudes of E-W and N-S components are usually approximately equal unless the surrounding geological structure is markedly unsymmetrical (e.g., Strasburg). The ratio of the horizontal to the vertical mean amplitude varies from 0.6 to 3 according to the underlying structure. Diurnal variations are sometimes regular, following local time, with a minimum by night and maximum by day; elsewhere they are quite irregular. They appear to be of local origin. To compare the amplitudes at different stations the recorded amplitudes are reduced to what they would be were the surrounding rock granite. Detailed comparison is made with meteorological conditions, but all that can be concluded is that microseismic storms are generally associated with depressions off the coast, but the one may apparently occur without the other. Current theories are discussed but none is found to give a satisfactory explanation [see Abstracts 3626-9 (1932)]. C. A. S.

***208. Theory of Seismographs with Electromagnetic Amplification.** J. Coulomb and G. Grenet. *Comptes Rendus*, 199. pp. 1144-1145, Nov. 19, 1934.—The principles of the theory of the galvanic registration of teleseisms is explained. From the equations the characteristics of the oscillating pendulum and of the galvanometer can be calculated. All realisable characteristics of the apparatus without reaction can be studied by considering successively the motions of the pendulum and galvanometer. The whole apparatus when reaction is negligible, as in the Galitzin, corresponds rigorously to an infinity of realisable forms and possesses the same characteristics, with considerable extension in the possibilities of construction. R. S. R.

***209. Mechanical Filter in Practical Seismometry.** G. Gamburgcev. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 3. pp. 507-510, Sept. 1, 1934. *German Abstract.*—An arrangement of pulleys is described for absorbing l.f. vibrations, to take the place of the more usual electrical arrangement. It is specially designed for employment in practical seismometry, in particular that depending on observations of reflected waves. C. A. S.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

210. Harmonic Analysis of Earth Currents. P. Rougerie. *Comptes Rendus*, 199. pp. 964-966, Nov. 5, 1934.—The data dealt with were the hourly values of the N-S earth currents from the beginning of May till the end of December, 1893. The diurnal wave has an amplitude which varies from day to day, the variability becoming more irregular during the last months of the year. The characteristic for each month is given in the form of an average in mV per km. for calm days and for disturbed days. An examination of the amplitude of the semi-diurnal wave reveals a periodicity of about half a month, but the effect cannot be ascribed with certainty to the moon as the cause. G. E. A.

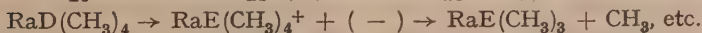
See also Abstracts 106, 272.

RADIOACTIVITY.

211. Radioactivity of Samarium. G. Ortner and J. Schintlmeister. *Zeits. f. Physik*, 90. 9-10. pp. 698-699, Sept. 6, 1934. *Akad. Wiss. Wien, Ber.* 143. 2a. 7. pp. 411-416, 1934.—Investigations, by means of a valve electrometer, of the radiation from samarium show that only one group of α -rays is emitted and that the range is 1.10 cm. in air, in agreement with the results of v. Hevesy, Pahl and Hosemann [see Abstract 3460 (1933)]. The proton and neutron emission is found to be negligible. [See Abstract 2827 (1934).] W. E. P.

212. Decay Constant of Ionium. F. Hernegger. *Akad. Wiss. Wien, Ber.* 143. 2a. 7. pp. 367-377, 1934.—The method used by the author consists in counting the number of α -particles emitted per sec. by ionium and calculating the decay constant from the formula $\lambda = 2Z_1/UtZ_0$ sec.⁻¹ where λ is the decay constant of Io, Z_1 is the number of α -particles emitted per sec. by the Io obtained from U gm. of U in a time t sec. and Z_0 is the number of α -particles emitted per sec. from 1 gm. of U. Two Io preparations were separated by a new method from two pure specimens of uranium salts of known ages and weights. A special ionisation chamber, connected to a valve electrometer, amplifier and recorder was used to count the α -particles. The two values of λ obtained agreed satisfactorily, that favoured by the author being $8.096 \times 10^{-6} \text{ yr}^{-1}$ corresponding to an average life of 124,000 yr. and a half-value period of 85,600 yr. W. E. P.

213. Molecular Changes in the Radioactive Transformation of Radium D. R. A. Mortensen and P. A. Leighton. *Am. Chem. Soc., J.* 56. pp. 2397-2398, Nov., 1934.—Experimental evidence is cited which shows that the radioactive transformation of RaD tetramethyl proceeds entirely to the formation of volatile compounds of RaE and F, presumably RaE (Bi) trimethyl and Po dimethyl. Thus the molecule of RaD tetramethyl is not completely broken down by the radioactive transformation, but adjusts itself to the new valency conditions by the loss of a methyl group and the completion of the electron pair by the acquisition of an electron from its surroundings, as follows:



This behaviour is in marked contrast to the effects of heat and light on the metal alkyls, both of which produce a decomposition into metal and hydrocarbons. While increased vibrational or electronic energy (heat or light) results in the disruption of all the metal-alkyl bonds, the expulsion of an electron from the nucleus apparently causes the rupture of one bond only. T. H. P.

214. Additional Radiations by Recoil from Active Deposit of Thorium. (Miss) C. Chamié. *Comptes Rendus*, 199. pp. 943-945, Nov. 5, 1934.—The anomalies [see Abstract 140 (1934)] have been further examined, chiefly by way of varying the period of activation. Some indication was obtained of a product of half life period 1.75 min. The anomalies are definitely not due to bombardment of the receiver by α -rays. They

may be due to unknown products in the active deposit of Th, or to a transmutation produced in the source by its own radiation. C. A. S.

215. Chemical Action of Radium Rays. A. Kailan. *Akad. Wiss. Wien, Ber.* 143. 2a. 5-6. pp. 163-174, 1934.—The action of the rays from 0.11 gm. of Ra, enclosed in a glass tube of wall thickness 1 mm., on aqueous solutions of (1) glycerin (2) isobutyl alcohol, (3) ethyl alcohol, (4) benzene was observed during periods ranging from a half to one year. The numbers of mono- or di-basic acid molecules formed per sec. in (1), (2) and (3) were determined. Electrical conductivity measurements indicated that the acid formed in the case of (1) and (3) is acetic, small quantities of formic acid being also present. Benzene appeared to be unaffected by the radiation. The observations of aldehyde and acid formation in alcohols indicate that the number of molecules affected per sec. by the radiation is approximately of the same order of magnitude as the number of ion-pairs formed per sec. in the liquid. W. E. P.

216. Range of α -Particles of Polonium in Relation to Intensity, Age of Preparation and Kind of Under Layer. Berta Karlik and Elisabeth Rona. *Akad. Wiss. Wien, Ber.* 143. 2a. 5-6. pp. 217-221, 1934.—Strong preparations are more inhomogeneous than is accounted for by self absorption and this inhomogeneity increases with time. Keeping in CO_2 leads to a shortening of the range. With relatively weak preparations giving a few hundred e.s.u. saturation current there was no penetration into the under layer in the cases of Ni and Pd, but there was in the cases of Au and quartz. J. E.

217. Low Energy β -Rays of Radium E. H. O. W. Richardson. *Roy. Soc., Proc.* 147A. pp. 442-454, Dec. 1, 1934.—By measuring the ranges of the β -rays from Ra E in an expansion chamber an energy distribution curve has been obtained extending from 10 to 65 kV. The absolute number of disintegrations represented by the curve is obtained from the growth of the succeeding α -ray body. The curve falls to fit the accepted energy distribution for Ra E. To attempt to account for this a calculation has been made of the energy distribution of secondary electrons due to branching of the primary rays which is to be expected. This distribution fails to agree in shape and in magnitude with the experimental curve and it is concluded either that the available data on branching are inadequate or that a group of low energy particles is emitted by Ra E. AUTHOR.

218. Upper Limits of the Continuous β -Ray Spectra of Thorium C and C". W. J. Henderson. *Roy. Soc., Proc.* 147A. pp. 572-582, Dec. 1, 1934.—The upper limits and the high energy parts of the continuous β -ray spectra of thorium C and thorium C" have been investigated by the method of magnetic focussing. A special coincidence counter which was relatively insensitive to γ -rays was used to count the β -rays. The values found for the upper limits of the spectra are interpreted in connection with modern views concerning the difference in binding energy between the parent and product nuclei of a β -ray disintegration. AUTHOR.

219. Diffusion of γ -Rays. E. Stahel and H. Ketelaar. *J. de Physique et le Radium*, 5. pp. 512-522, Oct., 1934.—Investigations of the diffusion of the γ -rays of Ra previously described [see Abstract 5250 (1933)] have been carried on with improvements in the methods of measurement. 2 gm. and 2.6 gm. of Ra were used as sources of the radiation. Study of the radiation diffused by thick screens has shown that Pb, Au, and W emit a radiation of which the hardest component is the same, within the

limits of accuracy of the measurements. This component has an apparent coefficient of absorption of 3.3×10^{-25} cm.²/electron, whilst the hardest components of the incident radiation, measured under the same conditions, have a coefficient of absorption of about 1.9×10^{-25} cm.²/el. Study of the radiation diffused by thin screens has shown that the metals heavier than Al diffuse a more abundant radiation. The excess does not vary as a function of the direction. The hard component alone represents 1/3 of this excess. In a discussion on the numerical value of the coefficient of nuclear diffusion certain limits are fixed for the photoelectric and nuclear coefficients of absorption. *Phys. Rev.*, 49, 1, 1941, 1-10. J. J. S.

*** 220. γ -Ray Spectroscopy by Crystalline Diffraction.** H. Hulubel and Yvette Cauchols. *Comptes Rendus*, 199. pp. 857-859, Oct. 29, 1934.—The paper describes briefly a focussing method applied to γ -ray spectroscopy by crystalline diffraction. The results of the test of the apparatus using X-rays and some preliminary results with γ -rays are given. After 2 hr. exposure, using 150-200 milli-curies of radon, strong γ -rays and fluorescent X-rays in the region of 160 x.u. are registered very clearly. After 12 hr. these rays are strongly over-exposed and a complex spectrum, very rich in X- and γ -rays, which extends to 350 x.u. is obtained. One exposure only is sufficient to cover a range of Bragg angles from 0.25° to 2° . *Phys. Rev.*, 49, 1, 1941, 11-14. W. E. P.

*** 221. Portable Geiger-Müller Tube Counter as a Detector for Radioactive Ores.** G. M. Shrum and R. Smith. *Canad. J. of Research*, 11. pp. 652-657, Nov., 1934.—A portable Geiger-Müller tube counter constructed for use as a geophysical instrument for locating radium-bearing ore bodies is described. Its chief characteristics are stability and low operating voltage, combined with great sensitivity to γ -radiation. The weight, using standard batteries, is about 55 lb. It is self-contained and can be used in rough country and in wet weather. Other uses suggested are in connection with natural gas wells, radium springs, mining operations, and for the location of lost radium needles and preparations used in hospitals. *Phys. Rev.*, 49, 1, 1941, 15-18. AUTHORS.

See also Abstracts 8, 13, 14, 24, 34, 301, 363.

RADIATION.

ABSORPTION AND TRANSMISSION.

222. Temperature Dependence of Infra-Red Absorption of Crystals. Part I. Fluorite and Calcite. F. Matossi and H. Brix. Part II. Sulphates and Mica. F. Matossi and H. Kindler. *Zeits. f. Physik*, 92, 5-6. pp. 303-336, Nov. 26, 1934.—In Part I transmissivities are recorded for temperatures between -168° and 300° C. For fluorite there is a transmissivity minimum at 13.8μ . The active proper frequency of fluorite is at 41.4μ . Combination oscillations of calcite and fluorite became more diffuse and broader with increasing temperature. In Part II data are recorded at temperatures between -125 to 300° C. and wave-length between 2 and 20μ for three sulphates, anhydrite, celestine and barytes, and for two micas, muscovite and klnochlor. In sulphates there is clearly an excitation effect. In the micas there is a "transition point" near 100° C. The question of the existence of a "ground absorption" and the course of the temperature coefficients in the absorption maximum of a characteristic vibration are discussed.

W. R. A.

223. Transparency of Thin Metallic Films in the Ultra-Violet. H. H. Hartzler. *J.O.S.A.* 24. pp. 339-341, Dec., 1934.—A technique for investigating the transparency of metallic films from the visible down to $1300\text{\AA}$ is described and results are given for ten different metals investigated. No new strong regions of transparency were discovered. AUTHOR.

***224. Opacity Meter. V. Šoronov. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.*, 3. pp. 502-505, Sept. 1, 1934. In German.**—Describes an opacity meter in which it is possible to produce two effects on the field of view simultaneously and independently of each other. The brightness of the field (which consists of a dark object on a bright background) can be varied by means of a wedge, and a given uniform brightness of any desired intensity can be superimposed on the field. The author proposes a quantitative expression for the opacity of the medium between the instrument and the object viewed, this expression being a function of the wedge reading and of the superimposed brightness.

J. W. T. W.

See also Abstract 40.

COLORIMETRY.

***225. Trichromatic Colorimeter. H. P. J. Verbeek. *Physica*, 1. pp. 1082-1084, Oct.-Nov., 1934. In English.**—Describes a modification of the author's instrument [see Abstract 2937 (1933)] in which the Maxwellian-view method of illuminating the parts of the matching field is abandoned in favour of an optical system in which the whole of the pupillary aperture is filled with images of the two surfaces to be compared. Further, the brightness of the "unknown" field is varied by means of a Brodhun sector instead of by moving the light source.

J. W. T. W.

***226. Precision Colorimeter. J. J. Manley. *Phys. Soc., Proc.* 47. pp. 69-73, Jan., 1935.**—In this paper is given a description of a colorimeter in which use is made of a simple optical system for juxtaposing the two beams of light. Novel methods are introduced for equalising the

tints of the two columns of liquid and for determining the difference between their lengths. AUTHOR.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

227. Kerr Effect in Solutions. W. Joffe. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 3. pp. 494-496, Sept. 1, 1934. In German.—Measurements were made with solutions of C_6H_6 , CCl_4 , C_7H_{16} in $C_6H_5NO_2$. It was found that the molecular constant remained unchanged up to a certain concentration after which it decreased and approached the value for pure $C_6H_5NO_2$, that is about ten times smaller. The association of the dipoles only began at the point where the molecular constant began to decrease. R. L.

228. Magnetic Birefringence and the Critical Solution Point. A. Piekara. *J. de Physique et le Radium*, 5. pp. 541-544, Oct., 1934.—The variation of magnetic birefringence with temperature at different concentrations is studied in mixtures of nitrobenzene and hexane, the dielectric properties of which have been studied previously [see Abstract 2620 (1934)], and nitrobenzene and CCl_4 . The results are tabulated and curves given. The thermal coefficient of magnetic birefringence increases with concentration; the form of the curves is similar in both mixtures, except that in the case of the nitrobenzenehexane mixture the coefficient becomes abnormally large at the critical solution point. The results are explained by assuming that the increase of molecular association of nitrobenzene at higher concentrations causes an increase in the molecular and magneto-optic anisotropy. W. R. A.

229. Superposition of Electric and Magnetic Double Refraction. M. Scherer and A. Piekara. *J. de Physique et le Radium*, 5. pp. 568-570, Nov., 1934.—It is shown that the double refraction produced in liquids (toluene, CS_2 , α -methyl naphthalene, etc.) by magnetic and electric fields, inclined at any angle, acting together, can be derived from the double refractions induced by the two fields acting separately on the assumption that the electric and magnetic effects operate independently. This result differs from that found for certain crystalline suspensions in which the additive law is not obeyed. W. S. S.

230. Thermal Variation of the Magnetic Birefringence of Paramagnetic Solutions of Salts of the Rare Earths. C. Haenny. *Comptes Rendus*, 199. pp. 1207-1209, Nov. 26, 1934.—The author describes measurements of the thermal birefringence of aqueous solutions and of one alcoholic solution of several salts of cerium and one salt of terbium. The temperature of the liquid was varied progressively by employment of the arrangement described by Goldet [see Abstract 588 (1934)]. Curves are given of the results. The thermal variations are larger and decrease more rapidly with temperature than those for diamagnetic substances. These facts are in good agreement with theoretical considerations put forward. R. L.

231. Verdet Constant of Heavy Water. F. G. Slack. *Phys. Rev.* 46. pp. 945-947, Dec. 1, 1934.—The Verdet constants of samples of water containing 0, 31.1, and 99.7 % of heavy hydrogen atoms have been measured for the wave-lengths 5893 and 5460.7 Å at 20° C. The results are given in tabular form. From these data the Verdet constant of pure heavy water (H_2O) is found to be 3.93 % less than that of ordinary water for both wave-lengths. Non-linearity of the Verdet constant-concentration relation leads to the calculation of an apparent Verdet constant for

$\text{H}^1\text{H}^2\text{O}$ which is 0.85 % less than the Verdet constant of ordinary water. Values of the relative molecular rotatory power and of the magnetic rotatory dispersions are also given. AUTHOR.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

232. Re-Emission of Mercury Vapour Bands in Fluorescence. (Miss) A. Faterson. *Acad. Polonaise Sci. et Lettres, Bull.* 5-7A. pp. 239-241, May-July, 1934. *In French.*—Working at pressures of 100 mm. and a temperature of about 450°C the re-emission in Hg vapour fluorescence of the rays Zn 2139, 2100, 2164 and Cd 2144 has been observed. It appears that the Hg molecules are responsible since (1) the re-emission occurs in the region of strong molecular absorption and its intensity varies with pressure in the same way as does that of the fluorescence. (2) In the analogous observations with Cd vapour the re-emission and the fluorescence in the same region shows the same degree of polarisation. J. E.

233. Extinction of Fluorescence of a Solution of Biacene in *p*-Dichlorobenzene, at a Temperature of -180°C . (Miss) B. Twarowska. *Acad. Polonaise Sci. et Lettres, Bull.* 5-7A. pp. 242-245, May-July, 1934. *In French.*—Unlike the fluorescence of biacene in other solvents, that in *p*-dichlorobenzene, disappears at -180°C . Microscopic study of the solution that has been cooled to -180°C . shows that the disappearance of the fluorescence corresponds to the disappearance of true solution, since crystals of the solute itself are observable and of the solvent but of nothing else. J. E.

234. Quenching of Fluorescence of Adsorbed Dyestuffs by Gases. V. Kondratjew and M. Siskin. *Phys. Zeits. d. Sowjetunion*, 6. 3. pp. 293-308, 1934. *In German.*—The influence of N_2 , CO, NO, and O_2 on the brightness of fluorescence of benzoflavin adsorbed in silica gel and of fluorescein by O_2 has been studied. NO and O_2 have a marked effect of quenching on benzoflavin. The relative intensity falls off hyperbolically with the gas pressure in the case of O_2 . The probability of energy exchange between an excited benzoflavin molecule and the adsorbed O_2 is considered to be high. An attempt is made from the quantitative results to estimate the size of the molecule and life of the excited state of benzoflavin. J. E.

235. Fluorescence of Solutions of Platinocyanides. I. Chvostikov. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 4. pp. 14-20, Oct. 11, 1934. *In German.*—So far attempts to make solutions of platinocyanides fluorescence have failed, indicating that the fluorescence of the salt is due to impurities and is not an inherent property. The authors, however, have now obtained solutions of platinocyanides which show appreciable fluorescence. The aqueous solution of potassium platinocyanide shows a spectrum having 2 bands with maxima at 525 and 555 $\mu\mu$. The latter band is the same as one of the crystal bands. The absorption spectrum shows maxima at 254 and 279 $\mu\mu$. Measurements of the polarisation of the fluorescence with various solvents give by use of the Perrin formula a time for the life of the excited molecule as about 3×10^{-10} sec. Another estimate of this life was made by use of the theory of quenching by foreign substances. This gave 1.5×10^{-10} sec. A third method depending on the effect of foreign substances on the polarisation gave a life of 3.5×10^{-10} sec. J. E.

236. Fluorescence of Cyclohexane. K. Haberl. *Ann. d. Physik*, 21. 3. pp. 301-302, Nov., 1934.—The Raman spectrum has superimposed on it the fluorescence bands with maxima at about 4000 Å and 2900 Å. The intensity of the fluorescence is very sensitive to temperature, falling rapidly from 50° to 20° C. Filtering the Hg light through glass suppressed the luminescence showing that the exciting waves are less than 3000 Å. The unmodified scattering shows a temperature change of intensity parallel to that of the fluorescence showing that it cannot be wholly Rayleigh scattering. No general explanation is attempted here. J. E.

237. Luminescence Excited by Rolling Mercury in a Glass Tube Filled with Impure Neon at Low Pressures. G. Déjardin and (Miss) R. Schwéglér. *Comptes Rendus*, 199. pp. 1110-1112, Nov. 19, 1934.—A flask filled with impure Ne and containing a large drop of Hg was rotated rapidly by a motor. The luminescence disappears after some hours' working but reappears after a rest. The fatigue effect does not occur if the *outside* of the flask is rubbed during the motion. An exposure of 12 hr. with a spectroscope having an aperture of F/1 gave in addition to Hg lines, some lines which have great similarity with those of the aurora. These lines can be attributed within the limits of error, of the rather feeble dispersion, to Ne molecules and atoms. A table of numbers shows the comparison between the luminescence lines and those of the aurora and of the night sky. J. E.

238. Influence of Potassium Iodide on the Polarisation of the Fluorescence of Dye Solutions. S. M. Mitra. *Zeits. f. Physik*, 92. 1-2. pp. 61-63, Nov. 2, 1934.—The influence of KI on the fluorescence of fluorescein and rhodamine B in water, in a mixture of glycerin and water, and in pure glycerin is investigated. It is found that when water is the solvent the polarisation increases with the concentration of the iodide. In the case of glycerin and aqueous glycerin the polarisation increases to a maximum which varies for different dyes and different exciting wave-lengths. In fluorescein these maximum values of the polarisation are 50 and 45 for the wave-lengths 4358 Å and 3650 Å, respectively. H. L. B.

239. Effect of Hydrogen on the Afterglow in Mercury Vapour. M. M. Mann and W. M. Nielsen. *Phys. Rev.* 46. pp. 991-994, Dec. 1, 1934.—Observations have been made on the change in intensity of the radiation in the mercury afterglow when hydrogen was introduced into the luminous vapour stream. It has been found that with no potential applied to a grid embedded in the vapour stream, the introduction of hydrogen to a pressure of 4×10^{-4} mm. of Hg (at the point of observation) decreases slightly but definitely the intensity of the afterglow. With higher hydrogen pressures, but with other conditions the same, the lines increase in density. With grid potentials of from 3.5 to 4 volts (positive with respect to the anode) additional excitation takes place in the vicinity of the grid and the introduction of hydrogen to a pressure of 4×10^{-4} mm. of Hg brings about a marked reduction in the intensity of the lines emitted in the afterglow. It is suggested that the intensity of the lines in the mercury afterglow when excited under these conditions is in part dependent upon the concentration of atoms in the 6^3P_{012} states. AUTHORS.

240. Oxygen Afterglow. E. M. Stoddart. *Roy. Soc., Proc.* 147A. pp. 454-467, Dec. 1, 1934.—Pure oxygen is glowless in "clean" and "poisoned" vessels when excited electrodelessly. Addition of various gases, including nitrogen, does not restore the afterglow. Pure oxygen is glowless in ordinary discharge tubes provided the electrodes are

thoroughly de-gassed. Addition of various gases showed that only nitrogen was able to restore the glow. Ordinary electrode discharges through oxygen-nitrogen mixtures readily synthesised NO, whereas the synthesis did not take place if electrodeless discharges were employed. Addition of NO to an electrodeless discharge through pure oxygen produced an afterglow. Glowing oxygen could be rendered glowless by trapping some active constituent from the gas at -80°C . This constituent was found to be NO_2 . The afterglow spectrum has been carefully examined and found to consist of weak diffuse bands from $4200\text{ \AA}$ to $6700\text{ \AA}$. It is concluded that the oxygen afterglow is due to the same emitter as present in the NO-O_3 reaction. AUTHOR.

INTERFERENCE. DIFFRACTION AND SCATTERING.

241. Interference Colours of Thin Films of Oxides, Sulphides or Iodides Upon Metals. U. R. Evans. *Kolloid Zeits.* 69. pp. 129-137, Nov., 1934.—The sequence of interference colours which are observed on metals coated with thin films of oxides, sulphides or iodides, differs from the neutron ring sequence if the observation is made in transmitted light. Usually there occurs a silver-like gap on metals where the first green appears at the Newton rings. This difference is traced to optical causes. The simple method of preserving the thickness of a film upon a metal, which depends on the division of the thickness of the air films, is only approximately valid since it depends upon three assumptions which are either doubtful or inexact. Very transparent films such as silver iodide, lead oxide or aluminium hydroxide, give five orders of colours on metals, but fewer occur with the less transparent films such as iron oxide. Lead oxide films can be mechanically removed from the metallic basis and still exhibit beautiful colours after their removal. The colours observed in reflected light are complementary to those in transmitted light. Other oxide films can be isolated electrochemically or chemically from their basis, and while iron oxide films exhibit no noteworthy interference colours after removal the nickel oxide films give excellent colours which are approximately (but not exactly) complementary to the film-on-metal colours. Copper coated with cuprous oxide gives four orders of colours which are concealed by an outer coating of cupric oxide; the colours observed in scattered light are complementary to those in reflected light. All the observations are explained on simple optical theory.

H. H. Ho.

242. Optical Laue Diagrams from Quartz. C. Schaefer and L. Bergmann. *Preuss. Akad. Wiss., Berlin, Ber.* 13. pp. 192-193, 1934.—The previous work of the authors in which optical Laue diagrams are obtained from a liquid [see Abstract 3666 (1934)] is extended to the case of a solid. A beam of light is passed through a piezoelectric quartz oscillator and the Laue effect is again obtained. The symmetry of the photograph is connected with that of the crystal but the exact relationship cannot yet be definitely stated.

J. T.

243. Fresnel Diffraction with a Wide Source. F. Wolfers. *J. de Physique et le Radium*, 5. pp. 585-596, Dec., 1934.—The theory of the diffraction patterns produced by a straight edge illuminated by a wide slit parallel to it and with uniform intensity distribution is developed. The study of the position of the fringes in relation to the width of the source reveals pseudo-discontinuities which obey very simple laws. In particular, the conditions under which the diffraction and the supplementary fringes

superpose are examined. The control experiments are described, and a good agreement between theory and experiment is obtained. C. B. A.

244. Photoelectric Photometry of Light Scattering in Fluids. R. Ananthakrishnan. *Indian Acad. Sci., Proc.* 1A. pp. 201-210, Oct., 1934.—The paper deals with a photoelectric method for measurement of the intensities of scattering in liquids, which is much quicker and more convenient than the visual methods hitherto employed. Results of the measurements in the case of a few liquids show good agreement between the results of photoelectric and visual photometry. The possibility of extending the method to depolarisation measurements is outlined.

AUTHOR.

245. Optical Evidence for Molecular Clustering in Fluids. R. S. Krishnan. *Indian Acad. Sci., Proc.* 1A. pp. 211-216, Oct., 1934.—It is pointed out that the presence of molecular clusters in fluids of size comparable with the wave-length of light should be capable of detection by two optical methods, one based on the asymmetry of scattering, and the second based on the anomalous depolarisation of scattered light. In this investigation the second method is developed. Ordinary liquids did not give any positive evidence for the existence of large molecular aggregates at room-temperatures. A mixture of CS_2 and MeOH when examined gave definite evidence for the formation of molecular clusters in the mixture by the observation of the anomalous depolarisation. This method is so delicate that it has made it possible to detect the presence of molecular clusters in the mixtures even at temperatures considerably removed from the critical solution temperature.

AUTHOR.

246. Combination-Scattering and Association of Molecules. S. I. Leitman and S. A. Ukholin. *J. Chem. Phys.* 2. pp. 825-826, Dec., 1934.—The molecular association of polar liquids was studied by the combination-scattering (Raman-spectra) method. In the spectra of a water solution of acetic acid the lines corresponding to the wave number 623 cm^{-1} changed their relative intensity at a change of the concentration of solution. This wave number is therefore characteristic of acetic acid complex molecules. No associative lines were observed in the combination spectra of nitrobenzol solution in CCl_4 .

AUTHORS.

247. Compensation of Aberrations of the Concave Grating. R. O. Anderson and J. E. Mack. *J.O.S.A.* 24. pp. 292-298, Nov., 1934.—From the method of Mack, Stehn and Edlén [see Abstract 3048 (1933)] and of Bowen [see Abstract 4544 (1933)], an expression is obtained for the intensity in the neighbourhood of a monochromatic geometric image of a concave diffraction grating slit, and is evaluated graphically for some special cases. The effect is examined of Bowen's method of fourth-power compensation on speed, resolving power, detection of weak lines near strong ones, measurement of small separations and freedom from general blackening near strong lines. Values are calculated of the normal displacement of the slit from the Rowland circle necessary to compensate for the fourth power aberration with a defined second power term. A discussion is given of the practical limits of tolerance for fairly good definition and some values are tabulated for the concave grating spectrograph. I. S.

***248. Auxiliary Lens for Concave Grating.** J. B. Green and R. A. Loring. *J.O.S.A.* 24. pp. 348-350, Dec., 1934.—A discussion of the elementary theory of the astigmatism of the concave grating. A spherocylindrical lens placed in front of the plate serves to produce a stigmatic image of the slit and increases the speed of the instrument by about

25 $\times$ and doubles the dispersion, allowing the full theoretical resolving power to be realised. AUTHORS.

See also Abstracts 224, 265, 282, 283, 401, 402, 515, 516, 517.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

249. Photochemistry of Mixtures of Chlorine and Ozone. A. C. Byrns and G. K. Rollefson. *Am. Chem. Soc., J.* 56. pp. 2245-2250, Nov., 1934.—It has been shown that when mixtures of chlorine and ozone are illuminated with blue light two oxides of chlorine having the formulæ ClO_3 and Cl_2O_7 are formed in appreciable quantities. The Cl_2O_7 is relatively inert chemically and tends to remain in the system unchanged once it is formed. The factors influencing the amount of this oxide formed have been studied. The ClO_3 undergoes a thermal decomposition, a chlorine-sensitised photodecomposition, and a reaction with ozone. One product of the latter reaction is Cl_2O_7 . Evidence has been presented that one of the primary products in the thermal decomposition is ClO_2 . The bearing of all these reactions on the previous observations of the chlorine-sensitised decomposition of ozone has been discussed. AUTHORS.

250. Free Radicals and Atoms in Primary Photochemical Processes. T. G. Pearson. *Chem. Soc., J.* pp. 1718-1722, Nov., 1934.—Free alkyl radicals have been isolated from the primary products of the photolysis of acetone, methyl ethyl ketone, and diethyl ketone, and characterised by their reactions with antimony, tellurium, and lead. Free radicals could not be detected in the photolysis of methyl butyl ketone, acetaldehyde, or propaldehyde. These findings confirm the mechanism suggested by Norrish and Kirkbride and by Norrish for the photolysis of aliphatic aldehydes and ketones. [See Abstracts 258 (1932) and 876 (1934).] The half-life period of the radicals from acetone under the experimental conditions is 5.3×10^{-3} sec. The method is now being applied to a large number of photochemical reactions, and with the provision of a more powerful source of ultra-violet radiation it is hoped to identify by direct chemical tests the primary products of the reactions. AUTHOR.

251. Spectra and Photochemical Decomposition of Metallic Carbonyls. Part II. Photochemical Data. A. P. Garratt and H. W. Thompson. *Chem. Soc., J.* pp. 1817-1822, Nov., 1934.—The rate of photochemical decomposition of nickel carbonyl has been measured in light of different wave-lengths, in the gaseous phase and in the solvents CCl_4 , hexane and cyclohexane. In the gas phase a thermal recombination balances the photochemical decomposition, so that no change is observed. In the solvents, the quantum efficiency increases somewhat with the frequency from a threshold value corresponding with the limit of continuous absorption in the spectrum. Taken as a whole, the observed facts are in accord with the mechanism; (1) $\text{Ni}(\text{CO})_4 + h\nu \rightarrow \text{Ni}(\text{CO})_3 + \text{CO}$; (2) $\text{Ni}(\text{CO})_3 \rightarrow \text{Ni} + 3\text{CO}$; (3) $\text{Ni}(\text{CO})_3 + \text{CO} \rightarrow \text{Ni}(\text{CO})_4$. Various points relating to these processes are discussed. [For Part I see Abstract 2453 (1934).] T. H. P.

252. Examination of the German "Din 4512." R. Luther and H. Staude. *Fot. Indust.* 32. pp. 1139-1142 and 1144, Oct. 24, 1934.—Briefly describes the results obtained from an examination of 1000 separate photographs on 16 different emulsions, taken in order to determine the usefulness of Din 4512 in actual practice. Two different sets of results were obtained, first using only one camera and then four, both groups

indicating the practical utility of the specification. It must be remembered that the Din number is not a general qualitative value, for an emulsion in spite of its higher Din sensitivity can be of less practical use than one of a lower sensitivity. Also, the practical sensitivity of negative emulsion is closely related to the sensitisation, and the fine grain condition of the emulsion is connected with the practical sensitivity. The useful region of the Din 4512 extends to the positive picture of the object as viewed, but there are a number of other photographic uses in which the relationship between Din sensitivity and commercial sensitivity is not absolute. R. C. F.

253. Higher Order Reversals in the Solarisation Region. L. T. DeVore and W. J. Saylor. *J.O.S.A.* 24. pp. 303-304, Nov., 1934.—Summarises the results of an attempt to extend the solarisation region to reversals of higher order. From preliminary experiments it was decided to use a process panchromatic emulsion, a logarithmic time scale, and elon hydroquinone developer with a 2 min., development time. The sun's radiation was reflected into the laboratory by means of a Foucault heliostat and there again reflected into a Hardy type sensitometer. Exposure times varied between 0.003 sec. and 4 hr. 16 min. The results obtained showed two maxima, one with a density of 2.21 and the other with a density of 1.53, the minimum density between the first and second reversals being 1.4. The curve of density against log. time showed three straight line sections, the slope in the normal exposure region being the same as that in the region of the second reversal, and the curve indicates a repeating process with decreasing straight line sections. R. C. F.

254. Photophysical Changes in Silver-Silver Chloride Systems. A. E. Cameron and A. M. Taylor. *J.O.S.A.* 24. pp. 316-330, Dec., 1934.—In the field of photographic research there appear many puzzling phenomena which in themselves are of interest only as curiosities except in so far as the information which they may yield upon careful investigation leads to a more complete and precise understanding of the fundamental photographic reactions involved in the formation of a latent photographic image and its subsequent development. The action of red polarised light upon certain non-optically sensitised photographic emulsions produces an image which is characterised by polarisation and is, in certain cases, photo-adapted so that it appears to be the colour of the light by which it was produced. An investigation of this phenomenon in its simplest form was undertaken by the authors in an effort to relate it if possible to accepted photographic theory and to arrive at an explanation which would be more satisfactory than those previously proposed. AUTHORS.

***255. Partial Solution of Integral Photography.** J. de Lassus. *Soc. Franç. Phot. et Ciné., Bull.* 21. pp. 205-218, Oct., 1934.—By integral photography is meant the obtaining of a photograph, so that, to several observers, by direct observation, the picture appears as though the actual object were being viewed. This was first attempted by Lippmann in 1907, the method he used being briefly described in the present paper. The method used by the present author is then discussed, it being based on stereoscopic photography together with translation, that is, on successive exposures, accompanied by horizontal translation of the plate, through each of a number of adjacent objectives instead of two, as in the usual stereoscopic camera. Actually, a web of fine vertical lines is used in place of the adjacent objectives, it being in contact with the emulsion, and during the taking of the photograph is displaced relative to the emulsion. R. C. F.

See also Abstracts 13, 133, 257, 281, 314.

PHOTOMETRY.

256. Precision Photometry. P. Copel. *J. de Physique et le Radium*, 5. pp. 563-567, Nov., 1934.—The author discusses the measurement of light flux to a precision of 1 part in 1000 by means of a photoelectric photometer. In aiming at this precision, statistical fluctuations may be important and the practical conclusion is that the light must be allowed to act on the cell for a certain minimum time. Different methods of employing the photoelectric cell in the photometric arrangement are considered, and the method advocated is a zero method in which the cell is exposed alternately to the two light fluxes at a "musical" frequency. The use of a heterodyne device in the detection of the out-of-balance signal is suggested. W. S. S.

***257. Combined Recording Microphotometer, Densitometer and Comparator.** P. A. Leighton, S. Smith and F. C. Henson. *Rev. Sci. Instruments*, 5. pp. 431-434, Dec., 1934.—An instrument which may be used as a registering microphotometer, a direct reading densitometer and a comparator has been constructed. It utilises a radiometer as the light-sensitive device. Records are taken on 4 by 10 in. photographic plates, direct readings on a 50 cm. scale, and intervals are read by means of a 10 in. comparator screw. AUTHORS.

***258. Microphotometric Methods in Divided-Beam Spectrophotometry.** D. H. Follett. *Phys. Soc., Proc.* 47. pp. 125-134; *Disc.*, 134-135, Jan. 1, 1935.—A microphotometer is described in which two photocells, connected differentially, are used to indicate the difference in transmission of the individual spectra in the pairs produced in divided-beam methods of spectrophotometry. Match points are thus found with much greater ease than by the visual method; much of the uncertainty which arises in visual matching disappears, though some remains owing to the irregularities of the photographed plate. AUTHOR.

259. New Photometric Method in Optical Spectrum Analysis. S. P. de Rubies. *Zeits. f. Physik*, 92. 3-4. pp. 228-231, Nov. 12, 1934.—The new method consists of photographing the spectrum upon a number of superimposed films and then measuring with a photometer the blackening, $\log(I_0/I)$, for a given line on each film. The sum of the blackenings is then shown to be equal to the total blackening. The usual restriction to blackening values on the straight part of the characteristic curve of a single photographic plate (between 0.5 and 2.5) is thereby removed, and it becomes possible to use total blackenings up to 8 without losing proportionality to intensity. It is suggested that the application of this method to spectrum analysis would allow of the use of larger quantities of material and stronger spectrum lines. L. A. W.

See also Abstracts 244, 434.

POLARISATION.

260. Rotatory Power and Ultra-Violet Rotatory Dispersion of Quartz for Rays Perpendicular to the Axis. G. Bruhat and P. Grivet. *Comptes Rendus*, 199. pp. 1034-1036, Nov. 12, 1934.—The rotatory power and ultra-violet rotatory dispersion of quartz in a direction perpendicular to the axis have been measured by methods previously described [see Abstract 4992 (1934)]. The sense of the rotation is opposite to that parallel to the axis. The rotation per mm. for 5893 Å is 11.5°, and

the dispersion is approximately the same as for the direction parallel to the axis. C. B. A.

261. Ultra-Violet Rotatory Dispersion of Camphor in Sulphuric Acid Solution. J. Lecompte and J. Perrichet. *Comptes Rendus*, 199, pp. 1202-1205, Nov. 26, 1934.—Examination of the rotatory power of camphor dissolved in sulphuric acid and water in various proportions for a series of ultra-violet wave-lengths shows, with the aid of a Darboux diagram, that solutions in strong sulphuric acid contain a third active substance in addition to the two already recognised in solutions in other acids. C. B. A.

262. Optical Investigation of Oxide Layer on Polished Iron Mirrors. L. Tronstad and T. Höverstad. *Zeits. f. phys. Chem.* 170, Abt. A. 3-4, pp. 172-190, 1934.—The removal of the oxide film from the surface of polished iron mirrors was effected by two processes. The thickness of the films, as indicated by an optical polarisation method, was shown to be about 20 Å, and therefore cannot be considered as a monomolecular oxygen layer. The complete removal of the film was effected by treatment with a zinc rod and brushes and at the same time anodically polarising, or in a solution of 0.2 N sodium oxalate and 0.02 N oxalic acid by repeatedly polarising cathodically and allowing to stand. The passive layer produced by anodic treatment in 1 N Na_2SO_4 was shown to have an average thickness of 50-70 Å and a refractive index of 3.5. By means of the new results the discrepancies between the results of W. J. Müller and W. Machu and those obtained by optical measurements in respect to the removal of the oxide layer are explained. [See following Abstract.]

F. J. B.

263. Optical Observations on the Effect of Ozone and Air on Metals. L. Tronstad and T. Höverstad. *Faraday Soc., Trans.* 30, pp. 1114-1127, Dec., 1934.—Drude's optical method [see Abstract 2103 (1933)] has been applied to obtain quantitative information concerning the films formed on Ag, Cu, Zn, Fe, eutectoid steel and austenitic steel in moist and dry ozone. In moist ozone no highly protective films were formed, and the attack is partly attributed to ordinary atmospheric corrosion. In dry ozone highly protective films (i.e., stationary optical states) were obtained with Ag, Fe, steel and stainless steel, and the results agreed well with those of previous work on passivity. The films on Cu and Zn proved less protective and stationary states could not be reached. On Zn in both dry and moist ozone as well as in pure air, the growth of the films revealed a linear arrangement—in accordance with observations on ordinary atmospheric corrosion; evidence is thus furnished of the reliability of the optical method used. The linear curves with Zn are discussed in relation to recent work on electron diffraction, and a tentative explanation is advanced. The films formed on Cu and Fe in iodine showed only slight resistance to the diffusion of the agent and must hence be porous or liable to crack. [See preceding Abstract.] T. H. P.

***264. Micro-Polariscopic Examination of Minerals.** N. Vedenejeva and S. Grum-Gržimajlo. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 3, pp. 583-588, Sept. 21, 1934. In French.—A device is described by which Umoff's method [see Abstract 169 (1913)] for observing weak absorption bands in the spectra of slightly absorbing substances can be used without his special apparatus. A quartz Savart plate, 4 mm. thick, is attached to the objective of a mineralogical microscope provided with a Bertrand lens and Abbe spectroscopic eye-piece. Dark lines, as in Umoff's

apparatus, become visible in the spectra on changing to conoscopic observation; moreover the polarising microscope extends the application of the method to anisotropic substances. The method is discussed mathematically, and illustrated by application to artificial ruby and staurolite, interference fringes as far as 625μ being rendered visible. C. A. S.

265. Polarisation by Diffraction at a Distance from a Steel Straight Edge. J. Savornin. *Comptes Rendus*, 199. pp. 941-943, Nov. 5, 1934.—In a previous note [see Abstract 1570 (1934)] it is shown that the polarisation given by good razor blades is less than that indicated by the theories of Poincaré or Epstein; this result may not be attributed to imperfect sharpness of the blades, which, on the contrary would have values too great. The author has investigated whether the divergence proceeds from the fact that the screen is not perfectly reflecting, and he has deduced (taking into account the results of Raman and Krishnan) that the polarisation becomes more feeble with decrease in reflective power, being zero for a perfectly black and perfectly sharp screen. Experimental data are included, and they verify, at least qualitatively, the theory proposed by Raman and Krishnan. H. H. Ho.

See also Abstracts 58, 248, 254, 334, 510.

RADIATION, EMISSION.

***266. Modern Methods of Infra-Red Spectroradiometry.** R. V. Jones. *Observatory*, 57. pp. 300-308, Oct., 1934.—A summary of recent developments in intensity measuring apparatus and auxiliaries, with special reference to the requirements of astronomy and to outstanding problems, such as the influence of Brownian fluctuations. References to the literature are included. T. L. M.

267. Refractive Indices of Liquids for Short Electric Waves. M. Miesowicz. *Acad. Polonaise Sci. et Lettres, Bull.* 3-4A. pp. 95-102, March-April, 1934. In German.—The wave-length in liquids of short-wave electric radiation is obtained by interference. The intensity of the wave is measured after a parallel beam has passed through a layer of liquid, the depth being varied. Then $\lambda/4$ equals the difference in depth of the liquid between minimum and maximum intensity. As benzole is non-polar in this region, the wave-length of the radiation, found as above, is multiplied by $\sqrt{e}$, where e is the dielectric constant, to obtain the wave-length λ_0 in air. This result is used to find the refractive indices "n" for water, some aqueous solutions and ether by the formula $\lambda_0 = n\lambda$. For water it is found that "n" is greater for shorter wave-lengths. H. M. B.

268. Short-Wave Radiation Generated by Spark Discharges. K. F. Lindman. *Soc. Scien. Fennica, Comm. Phys.-Math.* 7. 13. [80 pp.], 1934. In German.—Following a critical review of earlier researches, an account is given of an experimental investigation of oscillators of the Lodge and Righi type under varied excitation conditions. Experiments were also carried out with series arrangements of spheres or rods, in order to obtain data relative to the results of Glagolewa-Arkadiewa with metal particles. With the Lodge and Righi types of oscillators results were obtained in close agreement with those obtained by calculation from the dimensions of the spheres or rods employed. The results with the compound oscillators are not in agreement with the assumption of Glagolewa-Arkadiewa that single pairs of grains act as Hertzian oscillators of short wave-length. If this is the case it would appear that the radiated energy is quite small. [See Abstract 4993 (1934).] A. W.

269. Origin of Echoes of Long Path-Time. J. Fuchs. *Hochfrequenztechn. u. Elektroakustik*, 44. pp. 163-166, Nov., 1934.—A discussion is given of the view of Appleton and van der Pol that echoes of many seconds path-time (long-time echoes) are due to a reduction of the group velocity in the ionised layer. The fact that besides the echo signal the main signal is always observed as well, points to the conclusion that we are here concerned with a splitting of the signal sent out by the transmitter into two wave-trains with different directions of propagation. It is shown that such splitting is probably due to the influence of the earth's magnetic field and gives rise to a double refraction effect. In this case the main signal constitutes the ordinary ray while the extraordinary ray corresponds to the echo signal. Under this assumption the value calculated from the observational data by Appleton's law for the charge density at the highest point of the extraordinary ray fits in with modern theories of wave propagation and definitely locates the phenomena in the F-layer of the ionosphere. Moreover, this theory gives a simple explanation of other effects observed with long-time echoes, such as night effects, multiple long-time echoes, signal distortion, daily period and dependence on the earth's magnetism. The value of 0.5 per sec. found for the collision frequency at the highest point of the echo signal furnishes a useful starting point for improving our conceptions of the structure of the ionosphere. A. W.

270. Long-Distance Observations of Radio Waves of Medium Frequencies. D. F. Martyn, R. O. Cherry and A. L. Green. *Phys. Soc., Proc.* 47. [12 pp.], 1935. *Advance Proof*.—The frequency-change technique of Appleton and Barnett [see Abstract 790B (1926)] has been applied to the analysis of the downcoming waves from a distant transmitter. The observations were carried out simultaneously at distances of 25 and 700 km. from the emitter, which operated on a frequency of 1415 kc./sec. It was found that several downcoming waves were present at the more distant receiving station. Each of these waves was identified by using the path-length of the singly reflected wave from the E-layer as a reference. In this way it was found that the equivalent heights of both the E- and the F-layers are relatively stable over the 700-km. transmission path, and do not vary appreciably with the angle of incidence of the wave. The equivalent height of the F-layer showed a pronounced minimum at about 3 a.m. each morning. The rate of propagation of the minimum height in the horizontal direction appears to be slower than the rate of sunset propagation in the same direction. The ionisation-density in the E-layer in the early morning was always greater than 2.4×10^3 electrons per cm.³, and during half the period of the observations was less than 8.3×10^3 electrons per cm.³ The intermediate layer was observed regularly at sunrise. From the measurements of equivalent heights at different angles of incidence it is concluded that the gradient of ionisation at the lower boundary of the E-layer is sharp. AUTHORS.

271. Propagation of Medium Radio Waves in the Ionosphere. D. F. Martyn. *Phys. Soc., Proc.* 47. [17 pp.], 1935. *Advance Proof*.—All the available measurements of sky-wave intensities at medium frequencies are collated and expressed as field-strength, distance curves for six typical wave-lengths and for distances from 25 to 1000 km. It is shown how this material may be used for the determination of the non-fading radii of broadcasting emitters over country of any effective conductivity. From the observational material an empirical expression for the reflection coefficient of the lower E-layer of the ionosphere is derived. It is shown that

the observations are incompatible with the existence of a linear or parabolic gradient of ionisation in this layer. This incompatibility is not removed by the assumption of an absorbing or D-layer below the E-layer, or by consideration of the variation with height of the collision frequency ν of an electron with the air molecules in the E-layer. It is found that the observations can be fully explained if the gradient of ionisation is given by the exponential form $N = e^h$, where h is the height in km. above the region where ionisation first becomes appreciable. This gradient also gives rise to equivalent heights which are in agreement with experience. It is found that ν has a value of 10^6 collisions per sec. at a height of 90 km., in close agreement with Chapman's recent estimate. It is shown that the conclusions reached are not affected by use of the ray methods of geometrical optics, or by neglect of the influence of the earth's magnetic field.

AUTHOR.

***272. Heinrich-Hertz-Gesellschaft Wireless Expedition to Tromsø, 1932-1933. W. Stoffregen.** *E.N.T.* 11. pp. 341-350, Oct., 1934.—The present paper describes the apparatus and methods employed for (1) recording the brightness variation of the North light by photo-cell and amplifier apparatus; (2) recording field-strength and directional variations of European broadcasting stations; and (3) recording echoes. Circuit diagrams are given and also typical records obtained. [See Abstract 2007 (1934).]

A. W.

273. Influence of the Atmosphere on the Latitude Effect for Cosmic Radiation. G. B. Rizzo. *Accad. Lincei, Atti.* 20. pp. 183-186, Sept., 1934.—The diminution of the intensity of the cosmic radiation near the magnetic equator points to the conclusion that the rays are electrified corpuscles whose energy may be calculated. But the influence of the swelling out of the atmosphere in the equatorial regions should not be neglected in taking account of this diminution of intensity. By reason of centrifugal force and other causes, such as the action of the sun and moon which causes tides, and the heating of the atmosphere in the tropics, the terrestrial atmosphere has a lenticular form with the maximum height between the equator and the plane of the ecliptic. Thus in the equatorial region there is a greater absorption of the cosmic radiation due to the greater length of transit in the atmosphere and the greater density of the air.

J. J. S.

274. Probability of Multiple Processes at Very High Energies. W. Heitler and L. Nordheim. *Physica*, 1. pp. 1059-1072, Oct.-Nov., 1934. *In German.*—The authors calculate the probabilities of the following multiple processes: (1) scattering of a photon by a free electron with the production of two scattered photons, (2) emission of two photons by the interaction of a high speed electron with an atomic nucleus. In case (1) the probability is of the order 1/137th of the probability for simple Compton scattering, or less if the incident photon is not of energy greatly exceeding mc^2 . For case (2), again the probability is 1/137th of the probability for a single emission. It is concluded that the present wave mechanics theory gives no indication of the mode of origin of cosmic ray showers.

W. S. S.

275. Composition of Cosmic Rays. A. H. Compton and H. A. Bethe. *Nature*, 134. pp. 734-735, Nov. 10, 1934.—Reasons are given for believing that the three components of the cosmic radiation, designated A, B and C, in the order of their penetrating power, consist respectively of α -particles or photons, electrons, and protons. The most recent experimental results are shown to be consistent with the conclusion that B is

the shower-producing component and that it consists predominantly of positrons.

D. H. F.

276. Origin of Cosmic Rays. L. G. H. Huxley. *Phil. Mag.* 18. pp. 971-983, Nov., 1934. *Supplement*.—The author calculates the consequences of the hypothesis that the earth carries an electric charge, and that the cosmic radiation consists of charged particles which obtain their enormous energies under the earth's electrostatic attraction. It is shown that in order to account for the latitude effect, the earth's potential must be about 8×10^{10} volts, a value consistent with the observed energies of the radiation. The different components of the radiation must be particles of different mass and charge. The theory requires that the charge of all particles should be of the same sign, and the east-west effect requires that this sign be positive. It also follows that the radiation does not impinge on the earth's atmosphere isotropically. It is suggested that the earth's charge may be maintained by a stream of charged particles from the sun, but there are certain difficulties in this hypothesis. D. H. F.

***277. New Hg Vapour Lamps.** G. Déjardin and (Miss) R. Schwéglér. *Rev. d'Optique*, 13. pp. 251-258, Aug., 1934.—The construction of a number of Hg vapour lamps which may prove useful in scientific work is described. For work on the general radiation of the Hg discharge or in which a large source of uniform intensity is required, two models are described whereby an area of up to several square metres of sensibly uniform illumination may be obtained. For spectroscopic work requiring a narrow intense beam of radiation, a capillary tube system is employed; the glass is usually Pyrex but for U.V. work this is replaced by Wood's glass which transmits the U.V. radiation only. The energy distribution in the general radiation of a Hg lamp is given. A comparison of the intensity of 3 prominent lines in the low pressure Hg discharge and in the high pressure discharge (Hg arc) shows that, for $\lambda = 2537 \text{ \AA}$, the intensity is approximately the same, the energy consumed in the discharge being 30 and 250 W respectively. H. J. H. S.

See also Abstracts 349, 416, 430.

RADIATION, GENERAL THEORY.

278. Photon Spin. L. de Broglie and J. Winter. *Comptes Rendus*, 199. pp. 813-816, Oct. 29, 1934.—It is shown that an operator, defined in relation to the photon wave equation previously announced [see Abstract 4175 (1934)], is a first integral for the motion of the photon, and from this the components of the spin of the photon, and the terms corresponding to spin of zero, $-h/2\pi$, and $+h/2\pi$ are deduced. N. M. B.

279. Expression of Density in the New Photon Theory. L. de Broglie. *Comptes Rendus*, 199. pp. 1165-1168, Nov. 26, 1934.—An expression for the probability density is proposed which leads to results supporting the conception of the photon as two complementary particles, and introduces a factor expressing the Lorentz contraction for the postulated motion of the photon. N. M. B.

280. Equivalence of Light Quanta and Corpuscular Pairs. G. Wentzel. *Zeits. f. Physik*, 92. 5-6, pp. 337-358, Nov. 26, 1934.—Following along lines suggested by de Broglie [see Abstract 626 (1934)] the author develops a quantum theory of the electromagnetic field in which only corpuscles which obey a wave equation of Dirac type are considered.

J. S. G. T.

See also Abstract 100.

RADIATION, MECHANICAL EFFECTS.

See Abstract 163.

REFLECTION. REFRACTION AND DISPERSION.

***281. Measurement of Reflection Factor.** W. Bollmann. *Zeits. f. wiss. Phot.* 33. pp. 167-176, Nov., 1934.—Describes an instrument designed for the measurement of the reflection factors of such materials as photographic papers, textiles, etc. The material is placed side by side with a comparison surface of adjustable reflection factor and the two are equally illuminated and compared visually. The adjustable surface consists of a white sector of variable angular width rotating in front of a perfectly black surface. The angular width of the sector changes from a maximum at the centre to a minimum at the periphery, the change being either continuous or in steps; the apparent reflection factor therefore changes from unity to zero as the part of the sector exposed is shifted from the centre to the edge. Various precautions to be observed in using the instrument are described in the paper, which also contains a detailed account of the instrument and its construction. J. W. T. W.

282. Image Formation by Circular Ring. E. Böhme. *Ann. d. Physik*, 21. 1. pp. 15-36, Oct., 1934.—The theory of refraction at a circular ring is developed for point objects with reference to the position of maxima and minima; the relative intensity of the maxima is computed and found to agree with experiment. For the case of an extended object, the effect of the radius and of the width of the ring is investigated by graphical integration. In the case of the fixed circular ring, the visibility of the image and the ratio of maximum to minimum intensity are studied as empirical functions of the dimensions of the objective, in a suitable form for application. For a variable circular ring the positions where the diffraction rings disappear are examined. There is here a close resemblance to the effect observed by Michelson's interferometer. The nature of the image is suitable for the interferometric measurement of small objects. The relative advantages of the two methods are examined. T. L. M.

283. Distribution of Intensity in the Circle of Least Confusion Produced by Spherical Aberration. T. Malinowski. *Rev. d'Optique*, 13. pp. 233-246, Aug., 1934.—The distribution of light intensity in the circle of least confusion is studied, the relationship between the illumination i at a given point in the circle and its distance r from the axis being investigated. A simple plano-convex lens is the example treated. The curve of spherical aberration is found trigonometrically from the construction of the lens, and the values of i at a series of points are determined. A graph of $i = f(r)$ can then be constructed for three positions of the diaphragm. The results of the calculations are verified photographically and the rôle of spherical aberration in the phenomenon of diffraction is indicated. C. B. A.

284. Refractive Index and Molecular Refraction of SeH_2 at the D_3 -Line, 5875.6 Å. O. E. Frivold and O. Hassel. *Zeits. f. phys. Chem.* 27. Abt. B. 3-4. pp. 316-318, 1934.—The refractive index of SeH_2 at 5875.6 Å is measured interferometrically at room-temperature at pressures from 8 to 27 cm. of Hg, and the molecular refraction of the gas is calculated. C. B. A.

285. Physics of Glass. E. Berger. *Zeits. f. techn. Physik*, 15. 11. pp. 443-451, 1934.—A review of recent work on the physics of glasses, dealing

with the theory of the glass state, the relationship between the properties of glasses and their constitution, the influence of temperature on these properties, the effects of "heat history" of glasses, etc. C. B. A.

***286. Ultra-Violet Microscope for the Examination of Opaque Objects.** B. K. Johnson. *Journ. Sci. Instruments*, 11. pp. 384-394, Dec., 1934.—The paper describes the work which has led up to the design of a special form of microscope for the examination of opaque specimens in the ultra-violet. The following matters are discussed: the design of the optical system, the ultra-violet transmission of suitable materials, the ultra-violet reflecting power of certain metals, the fine adjustment, and the instrument in use. AUTHOR.

See also Abstracts 96, 262, 263, 267.

SPECTROSCOPY.

287. Iron Arc Spectrum from 8838 to 10219 Å. H. Dingle. *Roy. Astron. Soc., M.N.* 94. pp. 866-869, Oct., 1934 *Supplement*.—The spectrum of the iron arc in air at 110 volts is photographed in the region 8838 to 10219 Å in the first order of a 10-ft. Rowland concave grating with a dispersion of 5.3 Å per mm . Hypersensitised Eastman I/Q plates are used with exposures of 5 to 6 hr. The wave-lengths of about 60 lines are measured with an accuracy of $0.01\text{--}0.02 \text{ Å}$. The results are presented in tabular form and are intended to be used as convenient laboratory standards of wave-length in this hitherto inadequately calibrated region of the spectrum. J. E. K.

***288. Ultra-Violet Spectrum of Radon.** H. Pettersson. *Akad. Wiss. Wien, Ber.* 143. 2a. 5-6. pp. 303-311, 1934.—A small discharge-tube apparatus, suitable for use with Rn, is described. Details are given of the methods used for the purification of the emanation and its introduction into the tube. The wave-lengths and intensities of 169 lines between 3700 Å and 2280 Å, attributable to emanation, and mostly previously unknown are given in tables. It is proposed to extend the investigation of the spectrum by the use of still higher dispersions. J. E. R.

289. Spectrum of Polonium. Berta Karlik and H. Pettersson. *Akad. Wiss. Wien, Ber.* 143. 2a. 7. pp. 379-383, 1934.—A method is described for the observation of the optical spectra of substances of low volatility, in a high temperature quartz discharge tube, excited by short waves. Pt foil impregnated with Po was used, the polonium being volatilised in the tube at about 600°C . Two strong lines at 2450.0 and 2558.1 Å , which were undoubtedly due to Po, were found. The first has already been identified by Czapek as a "letzte" Po line; owing to its coincidence with lines due to known impurities, he was unable to allocate the second line to Po with any degree of certainty. A line at 3005 Å must still remain uncertain. Experiments were also carried out with H_2 , He and Ne in the tube. Further investigations in the visible and near ultra-violet are in progress. J. E. R.

290. Explosion Spectrum of Mercury. H. Nagaoka and T. Futagami. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers* No. 530. pp. 111-126, Nov., 1934. *In English*.—A steel explosion chamber is described in which a condensed spark could be passed to Hg issuing from a jet. The spectrum of this discharge was compared with that given by a special form of lamp in which the pressure rose to 960 mm., and also with a vacuum lamp. A table of observed lines and intensities is given and also

complete photometric curves from 4358 Å to 2492 Å. A 6-ft. concave grating was used for the spectrograms. F. S.

291. Arc Spectrum of Selenium, Se I. K. W. Meissner, O. Bartelt and L. Eckstein. *Zeits. f. Physik*, 91. 7-8. pp. 427-443, Oct. 12, 1934.—The spectrum was excited by a condensed discharge through selenium vapour and photographed with a 3 m. grating. Tables of wave-lengths and term values are given, and the known term-systems extended. F. S.

292. Spark Spectrum of Selenium, Se II. O. Bartelt. *Zeits. f. Physik*, 91. 7-8. pp. 444-470, Oct. 12, 1934.—A 3 m. concave grating was used with Ne lines as standards. Most of the recorded lines have been classified and the deepest term of the Hund system determined. This is taken to be the $5s^2 5p^3 4S$ term. F. S.

293. Fluorine Spectrum, F IV. B. Edlén. *Zeits. f. Physik*, 92. 1-2. pp. 19-26, Nov. 2, 1934.—About 250 lines in the wave-length range 140 Å to 3176 Å have been identified as combinations in the F IV spectrum. About 24 term values in the singlet system, 86 in the triplet and 31 in the quintet have been identified. The first two systems are linked by inter-combinations, while the ionisation-potential is given as 86.72 volts. F. S.

294. Mean Lives of Excited Hydrogen Atoms. J. H. E. Griffiths. *Roy. Soc., Proc.* 147A. pp. 547-555, Dec. 1, 1934.—The average lives of the excited states of hydrogen have been measured using a method described in a previous paper [see Abstract 1161 (1934)]. The values found were $1.75 \pm 0.3 \cdot 10^{-8}$ sec. for H_α and $3.1 \pm 0.5 \cdot 10^{-8}$ sec. for H_β as compared with the theoretical values of $1.52 \cdot 10^{-8}$ sec. and $3.13 \cdot 10^{-8}$ sec. for H_α and H_β respectively. The decrease of life with increasing water vapour pressure was used to find the effective collision radius for quenching collisions between excited hydrogen atoms and water molecules. This was found to be $6.57 \cdot 10^{-8}$ cm. and $9.5 \cdot 10^{-8}$ cm. for H_α and H_β respectively. This is almost exactly the same as the kinetic theory collision distance, taking the Bohr theory radius as the size of the hydrogen atom. It was shown that helium has no quenching effect. AUTHOR.

295. Absorption Spectrum of Rhombic Sulphur in Polarised Light. H. G. Smith and R. H. Craddock. *Roy. Soc. Canada, Trans.* 28. Sect. 3. pp. 173-176, May, 1934.—The absorption of plane polarised light at various visible wave-lengths has been measured in two sulphur plates, cut per pendicular to the x - and z - axes of the crystal respectively. Little difference is observed when the electric vector is in the z - or y - directions, but there is a marked difference between these and the x -direction. In this case, the long wave-length limit of the ultra-violet absorption is displaced (towards the red) by over 100 Å. C. B. A.

296. Absorption Spectra of the Samarium Ion in Solids. Part V. F. H. Spedding and R. S. Bear. *Phys. Rev.* 46. pp. 975-983, Dec. 1, 1934.—The absorption spectrum and energy levels indicated therein for the samarium ion in crystalline monoclinic $\text{Sm}_2(\text{SO}_4)_3 \cdot 8\text{H}_2\text{O}$ are shown to be similar to those of $\text{SmCl}_3 \cdot 6\text{H}_2\text{O}$, which is also a monoclinic salt. Absorption lines of the sulphate at temperatures between 20° K and room temperature are used to prove the existence of several low-lying levels separated from the basic one by 160, 188 and 225 cm^{-1} . These levels are of particular interest in view of heat capacity and magnetic studies of this salt. [For Part IV see Abstract 4194 (1934).] AUTHORS.

297. Structure of the Spectra of Hafnium and Tungsten. A. T. Williams. *Comptes Rendus*, 199. pp. 1201-1202, Nov. 26, 1934.—
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19 terms in the spectra of Hf (I and II) and 15 terms in the spectrum of W are classified. C. B. A.

298. Spectrum and Ionisation Potential of Radium. H. N.

Russell. *Phys. Rev.* 46. *pp.* 989-990, Dec. 1, 1934.—A new interpretation of the connection between the two groups of terms in Ra I found by Rasmussen [see Abstract 1588 (1934)] is suggested and confirmed by new observations which he has courteously communicated. Certain term-designations are altered. The first ionisation potential is 5·252 volts.

AUTHOR.

299. Transfer Probability in the Sharp and Diffuse Series of the Alkali Metals. L. S. Ornstein and J. Key. *Physica*, 1. *pp.* 945-952, Oct.-Nov., 1934. In German.—From intensity measurements of the spectral lines furnished by Na and K arcs calculations were made of the transfer probability for the lines of the *p-d* and *s-p* series. From previous measurements the transfer probability is also calculated for Rb and Cs. All the results are exhibited graphically. [See also Abstract 3848 (1934).]

A. W.

300. Nuclear Moment of Scandium. H. Kopfermann and E. Rasmussen. *Zeits. f. Physik*, 92. 1-2. *pp.* 82-86, Nov. 2, 1934.—From the hyperfine structure of the two ScI lines 6305 Å and 6210 Å the mechanical moment of momentum is found by calculation to be 7/2. The corresponding magnetic moment amounts to about 3·6 nuclear magnetons.

H. L. B.

301. Phenomenon Exhibited by the Isotopes of Samarium. H. Schüler and T. Schmidt. *Zeits. f. Physik*, 92. 1-2. *pp.* 148-152, Nov. 2, 1934.—Hyperfine structure investigations of several Sm lines reveal that the displacements between the individual lines of the even isotopes are not approximately constant as is the case with the corresponding displacements of other elements. The separation of the isotopes Sm¹⁵⁰ and Sm¹⁵² is twice as large as that of the isotopes Sm¹⁵² and Sm¹⁵⁴. It is concluded from the observations that there is a decisive difference between the structures of the nuclei of Sm¹⁵⁰ and Sm¹⁵². This structural difference is connected with the α -activity of Sm.

J. E. K.

302. Magnetic Moment of the Nucleus of Cæsium. D. A. Jackson. *Roy. Soc., Proc.* 147A. *pp.* 500-513, Dec. 1, 1934.—The hyperfine structure of five terms in the arc spectrum of cæsium was investigated. Using the formulæ of Goudsmit and of Fermi and Segré [see Abstracts 3015 and 3556 (1933)], values of the nuclear magnetic moment, which were in agreement within the limits of experimental accuracy, were found from all five terms; the mean value given by the most accurately known terms is 2·75/1838 magneton, with a probable error of less than 5 %; or if the formula for calculating the magnetic moment from the $S_{1/2}$ term is accurate the probable error is less than 1 %. AUTHOR.

303. Calculation of Spectral Terms. U. Fano. *N. Cimento*, 11. *pp.* 550-560, Aug.-Sept.-Oct., 1934.—A summary is given of the results hitherto obtained in the theoretical calculation of spectral terms of the complex atoms, excluding those of hydrogen, helium and the analogous ions.

J. J. S.

304. Interaction of Electronic and Nuclear Motions in Triatomic Rod-Shaped Molecules. R. Renner. *Zeits. f. Physik*, 92. 3-4. *pp.* 172-193, Nov. 12, 1934.—The structure of the π -term in the spectra of molecules of the CO₂ type, taking into account interaction between the electronic and nuclear motions is discussed mathematically.

J. S. G. T.

305. Calculation of Relative Multiplet Strengths in a Transition Array. G. H. Shortley. *Nat. Acad. Sci., Proc.* 20. pp. 591-593, Nov., 1934.—Sketches the method of calculating relative (dipole-) multiplet strengths in transition arrays to which general formulæ are applicable.

W. S. S.

306. General Expression for the Intensity of Hydrogen Lines. L. McLean. *Phil. Mag.* 18. pp. 845-874, Nov., 1934. *Supplement.*—A formula for the total intensity of hydrogen lines in the general case of the transition $n \rightarrow n^1$ is derived with the aid of wave-mechanical theory.

J. E. K.

307. Atomic Energy Relations. Part I. R. F. Bacher and S. Goudsmit. *Phys. Rev.* 46. pp. 948-969, Dec. 1, 1934.—A simple method for the calculation of approximate energies of atomic levels is presented in this paper. It is based on the derivation of linear relations which express the unknown energy in terms of observed energy values of the atom and its ions. It is shown that the degree of approximation increases with the amount of experimental data available for use in the calculation and also how the best formulæ can be obtained for each case. Several tables are given containing formulæ for configurations involving s and p electrons. They are applied to the spectra of C, N and O, and the energy values so determined are compared with those known from observations. In an Appendix the method of approximation is compared with the quantum mechanical perturbation method.

AUTHORS.

308. Band Spectrum of Manganese Oxide. A. K. Sen Gupta. *Zeits. f. Physik*, 91. 7-8. pp. 471-474, Oct. 12, 1934.—The spectrum of a manganese arc burning in air was photographed. New data are tabulated and the corresponding heat of dissociation given as 4.4 volts.

W. R. A.

309. Resonance Bands of HD-Hydrogen in the Region 1650 Å to 1000 Å. K. Mie. *Zeits. f. Physik*, 91. 7-8. pp. 475-492, Oct. 12, 1934.—The emission spectrum of a discharge in 0.3 mm. of A containing 0.02 mm. heavy hydrogen (D) is investigated. Selective rotation doublet series of HD are observed in the region 1650 to 1000 Å. Analysis reveals that these correspond to parts of HD-Lyman and HD-Werner band systems. The rotation and vibration constants of the HD-molecule determined experimentally are in complete agreement with the values calculated by isotope theory from the constants of the H_2 molecule. The energy of the ground state of the HD molecule is found to be 1888 cm^{-1} . The electron separation T_e of the band systems of HD is $15 \pm 10\text{ cm}^{-1}$ bigger than in H_2 , the corresponding separation in the D-atom being 30 cm^{-1} bigger than in the H-atom.

J. E. K.

310. Rotation-Vibration Spectra of Molecules Containing Deuterium. Part I. Spectrum of C_2HD and the C-C and C-H Distances in Acetylene. G. Herzberg, F. Patat and J. W. T. Spinks. *Zeits. f. Physik*, 92. 1-2. pp. 87-99, Nov. 2, 1934.—The absorption spectrum of acetylene prepared from 93 % and from 50 % heavy water is investigated in the photographic infra-red region. Four bands are found at 0.784 , 1.03 , 1.09 and 1.19μ , and are ascribed to C_2HD on account of the absence of alternation of intensity. The fine structure of the three bands of longest wave-length is analysed and hence the moment of inertia of the molecule C_2HD is calculated to be $27.899 \times 10^{-40}\text{ gm.cm.}^2$ in the ground state and approximately $27.753 \times 10^{-40}\text{ gm.cm.}^2$ in the unrealisable completely vibrationless state. From this last result, together with the known moment of inertia of ordinary acetylene, reliable values are calculated for the

nuclear distances in acetylene, viz. $C-H = 1.058 \text{ \AA}$ and $C-C = 1.199 \text{ \AA}$. These distances are smaller than those in the diatomic radicals CH and CC . Certain of the C_2HD bands are to be regarded as due to transitions which are forbidden for C_2H_2 on account of symmetry. The approximate values of the three valency vibration frequencies of C_2HD are found to be $\nu_1 = 1840$, $\nu_2 = 2570$, and $\nu_3 = 3330 \text{ cm}^{-1}$.

L. A. W.

311. Rotation-Vibration Bands of HCN. W. Scheib and K. Hedfeld. *Zeits. f. Physik*, 91. 11-12. pp. 792-795, Oct. 23, 1934.—The rotation-vibration spectrum of HCN was photographed with a Rowland grating. A new band at $10381 \text{ \AA}$ was found. The rotation structure was analysed. The moment of inertia for the initial and end states were calculated to be 20.00×10^{-40} and $19.44 \times 10^{-40} \text{ gm./cm.}^2$ respectively. The value $1.17 \times 10^{-8} \text{ cm.}$ was arrived at for the nuclear separation of the C-N group.

D. H. F.

312. Absorption Bands of HCN in the Photographic Infra-Red. G. Herzberg and J. W. T. Spinks. *Roy. Soc., Proc.* 147A. pp. 434-442, Dec. 1, 1934.—Two strong absorption bands of HCN at 1.04μ and 1.16μ have been photographed with high dispersion and analysed. The rotational constants and the moment of inertia of HCN in its lowest state are derived therefrom with considerable accuracy ($I_0 = 18.703 \times 10^{-40} \text{ gm.cm.}^2$). The internuclear distances are calculated from I_0 on the assumption that the CH distance is the same as in C_2H_2 . They are smaller than those in the free diatomic radicals. The effect of stretching of the HCN molecule by centrifugal force is considered. The positions of the different bands of HCN cannot be represented by a simple formula including only quadratic terms. The line width of the HCN lines increases rapidly with pressure. An equal amount of air produces far less broadening than HCN itself. The broadening is smaller for higher rotational lines. It seems probable that the broadening in this and other cases of infra-red spectra is due to a strong intermolecular interaction and not to a pure Lorentz collision broadening.

AUTHORS.

313. Infra-Red Spectrum of Methyl Chloride. A. H. Nielsen and E. F. Barker. *Phys. Rev.* 46. pp. 970-974, Dec. 1, 1934.—Certain new infra-red absorption bands of CH_3Cl were mapped in the region from 0.7μ to 7.0μ . In each case the bands show the structure predicted by the theory of the symmetry properties of molecules having three equal atoms. It is also predicted that every third line in the $\perp$ bands shall be enhanced. This was observed in the present investigation as well as previously by Bennett and Meyer [see Abstract 1208 (1929)]. Several new intervals between the lines in the $\perp$ bands were observed which may be of value with regard to a theoretical interpretation of this anomalous spacing. Two absorption regions, observed here, appear to give evidence of an interaction between the levels ν_1 and $2\nu_4$ thought to exist in some of the methyl compounds. These bands are $\nu_2 + (\nu_1, 2\nu_4)$ at 5900 cm^{-1} and $\nu_3 + (\nu_1, 2\nu_4)$ at 4200 cm^{-1} . A few lines of ν_3 in the P branch near the centre were resolved. The Q branch proved to be much more pronounced than Bennett and Meyer's work shows.

AUTHORS.

314. Absorption Spectra of Nitrates and Nitrites in Relation to their Photodissociation. K. S. Krishnan and A. C. Guha. *Indian Acad. Sci., Proc.* 1A. pp. 242-249, Oct., 1934.—The two absorption bands with long wave-length limits at 3500 and $2300 \text{ \AA}$ which are exhibited by solutions of inorganic nitrates are attributed to photodissociation of the nitrate into nitrite with an atom of oxygen in the normal (^3P) state or in

the excited ($^1D_2$) state respectively. The heat of dissociation deduced for O_2 is 114 k.cal./mol., and the energy of excitation of the oxygen atom ($^3P \rightarrow ^1D_2$) is 43 k.cal./mol., in agreement with spectroscopic values. The strong linear dichroism of both absorption bands (observed in the crystals) is attributed to difference in the quantum efficiency of the photochemical dissociation for the two directions of vibration of the polarised light. A similar explanation is suggested for the absorption spectrum of the nitrites. C. B. A.

315. Ultra-Violet Absorption of Potassium Nitrate, Nitrites, and Carbon Disulphide at Low Temperatures. G. Rodloff. *Zeits. f. Physik*, 91, 7-8. pp. 511-532, Oct. 12, 1934.—A continuation of the work of Schaumann [see Abstract 3730 (1932)]. The absorption spectra of KNO_3 , KNO_2 , and $NaNO_2$ crystals, and CS_2 are investigated at room-temperature, -180° , and -250° . The results are given in detail, and the pleochroism of KNO_3 is discussed. W. R. A.

316. Comparison of Ultra-Violet Absorption Spectra of Aqueous Solutions of Hydrochloric Acid and of Various Chlorides. R. Trehin. *Comptes Rendus*, 199. pp. 1047-1049, Nov. 12, 1934.—An account of the methods of preparation and the ultra-violet absorption spectra of aqueous solutions of pure chlorides of Ca, Mg, and Be, and a comparison of the results with those previously obtained for HCl and chlorides of the alkali metals. [See Abstract 1217 (1932).] C. B. A.

317. Ultra-Violet Band System of Neutral OH. Part III. T. Tanaka and Z. Koana. *Phys. Math. Soc., Japan, Proc.* 16. pp. 365-400, Nov., 1934. *In English*.—Identification and rotational analysis of new bands in this system [see Abstract 4526 (1933)] are greatly extended. The system is now:

v''	0	1	2	3	4
v'					
0	$\lambda\lambda 3064$	3428†			
1	2811	3122†	3484†		
2	2609	2875†	3185*		
3	2444*	2677*	2945*	3254*	
4		2517*	2753*	3022*	3331*

The authors have discovered and analysed the bands marked *, and re-investigated those marked † to test some conflicting results of previous analyses. More than 100 lines remain unassigned. In the source used (oxy-hydrogen flame) the existence of "unorthodox" satellite branches is doubtful. The more important constants are:

	Upper State, $^2\Sigma^+$	Lower State, $^2\Pi$
Rotational	B_e^* 17.351 ₂ cm. ⁻¹	18.861 ₈ cm. ⁻¹
	B_0^* 16.949 ₇ ..	18.515 ₂ ..
	a_e 0.796 ₉ ..	0.693 ₁ ..
	r_e 1.015 Å	0.9742 Å
Vibrational (from band-origins)	ω_e 3176.74 cm. ⁻¹	3727.95 cm. ⁻¹
	$x_e\omega_e$ 92.80 ..	78.15 ..
	$y_e\omega_e$ -0.967 ..	-1.000 ..
Energy of dissociation	D_0 2.737 V.	4.230 V.
System-origin	v_e 32681.16 cm. ⁻¹	

Interrelations of constants given by Mecke, Birge, Morse and Rydberg are verified to a considerable extent, but $\omega_e r_e^3$ decreases with increasing mass in

LiH, BeH, BH, OH, FH instead of remaining roughly constant. The observed intensity distribution agrees with the Condon curve derived from the $U : r$ curves obtained by means of Morse's and Rydberg's formulæ.

W. J.

318. New Ultra-Violet Resonance Band System of Hydrogen. Heats of Dissociation of H_2 , HD, D_2 and HCl. H. Beutler. *Zeits. f. phys. Chem.* 27. *Abt.B.* 3-4. *pp.* 287-302, 1934.—New lines have been detected in a discharge through A containing traces of H_2 . That these belong to H_2 was shown by comparison with the spectra of $A + HD$ and $A + HD + H_2$. They are attributed to a resonance band system, derived from $2 p \sigma^1 \Sigma^+, v' = 10, K' = 2 \rightarrow 1 s \sigma^1 \Sigma_g^+, v'' = 1$ to 14, $K'' = 1$ and 3. The excitation of the H_2 results from absorption of the A line $1066.4 \text{ \AA}$ by molecules in the level $v'' = 2, K'' = 1$. This term occurs only extremely rarely in the thermal equilibrium; a concentration sufficient for the intensity of the resonance radiation is obtained in the discharge through the stationary radiation state. From the extension of the series of vibrations v'' in H_2 by $v'' = 13$ and $= 15$, it appears that the number of vibration levels v'' is finite. An extrapolation of the heats of dissociation to $D_{H_2} = 102.68 \pm 0.12 \text{ k.cal.}$ also becomes possible. D_{HD} , D_{D_2} , and D_{HCl} are calculated as $103.50 \pm 0.12 \text{ k.cal.}$, $104.48 \pm 0.12 \text{ k.cal.}$, and $101.63 \pm 0.22 \text{ k.cal.}$ respectively (at $T = 0^\circ$). C. B. A.

319. Spectrum of the Flame of Ethylene. W. M. Vaidya. *Roy. Soc., Proc.* 147A. *pp.* 513-521, Dec. 1, 1934.—The inner cone of the flame of ethylene burning in a Smithells' flame separator has been found to yield a number of faint bands which have hitherto received little attention. The conditions for the occurrence of these bands have been investigated, and a table of their wave-lengths is given. The emitter of the bands is not precisely known, but there is reason to believe that they may be due to HCO. Support for this suggestion is given by a preliminary vibrational analysis and by chemical considerations. AUTHOR.

320. NH_3 Bands in the Near Infra-Red. S. K. Chakravorti. *Indian Phys. Math. J.* 5. *pp.* 25-33, Oct., 1934.—The fundamental frequencies are obtained by wave mechanics, the molecule being regarded as a symmetrical top of pyramidal form having N at the apex and H at each corner of the equilateral base. Energy E_v is calculated for three types of vibration: (a) axial oscillations of N, with symmetrical oscillations of each H keeping the N-H distances constant, (b) symmetrical oscillations of the H atoms on a spherical surface with N fixed at the centre, (c) symmetrical oscillations of the H atoms in lines joining them to N. The fundamentals obtained are $\nu 953.53 \text{ cm.}^{-1}$ or $\lambda 10.55 \mu$ for (a), $\nu 1629.6$ or $\lambda 6.13$ for (b) and $\nu 5347.6$ or $\lambda 1.87$ for (c). The first and second agree with the two strong bands regarded as fundamentals by most of the previous investigators, while the third does not coincide with any observed band. The calculated electric moment is 3.2 times the observed—an unexplained discrepancy as in the cases of H_2O and HCl. The fine structure is calculated for four branches of the $\lambda 10.55$ band and compared with observations [see Abstracts 139, 2484 and 3058 (1929)]; calculations for other branches are obvious.

W. J.

321. Interatomic Forces and Frequency of Oscillation of the Atoms in Lattices. S. Franchetti. *Accad. Lincei, Atti*, 20. *pp.* 186-191, Sept., 1934.—It is shown how it is possible to obtain in a simple way and with few hypotheses a relation between the function $f(r)$ which gives the force exerted between two atoms at the distance r (on the usual

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supposition of central forces) and a "principal" frequency with well-defined signification. The expression reached for the frequency after various approximations is: $\nu = (N^{\frac{1}{3}}/\pi) \sqrt{\frac{3}{2}} \delta^{-\frac{1}{3}} M^{-\frac{1}{2}} K^{-\frac{1}{2}}$, where N = number of atoms, δ = density, M = atomic weight, and K the compressibility.

J. J. S.

322. Normal Vibrations of Molecules Having Octahedral Symmetry. N. S. N. Nath. *Indian Acad. Sci., Proc. 1A*. pp. 250-259, Oct., 1934.—Expressions are obtained for the frequencies of the normal modes of the AB_6 model having octahedral symmetry, basing the constants of the potential energy function on three types of major forces (primary valence forces) and on some types of intra-valence forces. The various force constants of the SF_6 molecule are calculated and the probable positions of the frequencies of the infra-red active modes of the hexafluorides of Se and Te are predicted. [See Abstract 4385 (1934).] C. B. A.

323. Constants of HCl Molecule. P. Gombas and T. Neugebauer. *Zeits. f. Physik*, 92. 5-6. pp. 375-384, Nov. 26, 1934.—The most important constants of the HCl molecule are calculated by means of the ionic model and the Hartree eigen functions taking into consideration the inhomogeneity of the field through polarisation. The results show the nuclear distance to be 3.8 % too great, the dipole moment 19 % too great, and the wave-length of the oscillation frequency to be 3.9 % too small. The accuracy of the various methods employed for the above purpose is discussed. H. H. Ho.

324. Absorption of Light by Adsorbed Cæsium. J. H. de Boer, J. F. H. Custers and C. J. Dippel. *Physica*, 1. pp. 935-944, Oct.-Nov., 1934. *In German*.—Layers of Cs adsorbed on CaF_2 transmit bright blue light, being highly transparent in the ultra-violet but highly absorptive for wave-lengths above 440 $m\mu$. At low degrees of occupation the absorption is due to Cs atoms adsorbed on the active spots of the salt layer by electrostatic polarisation, whereas at high degrees of occupation the absorption is due mostly to atoms bound by van der Waals forces. At the lowest degrees of occupation the strong absorption beyond 440 $m\mu$ completely disappears, only the absorption spectrum of the electrostatically adsorbed atoms being measured, whilst with the highest degrees of occupation the spectrum is almost the same as that of a thin film of metallic Cs. A method for lowering the degree of occupation of the Cs layer by means of lead is described. T. H. P.

325. Ultra-Violet Absorption of Methane. A. B. F. Duncan and J. P. Howe. *J. Chem. Phys.* 2. pp. 851-852, Dec., 1934.—The absorption spectrum of methane from 1450 Å to 850 Å is found to be entirely continuous and all excited states up to the first ionisation potential are repulsive. AUTHORS.

326. Fluorescence and Absorption Spectra of Iodine Vapour. I. I. Agarbiceanu. *Ann. de Physique*, 2. pp. 347-447, Nov., 1934.—Anti-Stokes lines have been obtained with narrow excitation lines, 6 of them for the first time. It has been shown that the excitation of anti-Stokes lines is in fact independent of the width of the exciting line. Considerations of the positions, relative to the potential curves, of the normal and excited states, together with the characteristic functions of the vibration states permits the compatibility of the presence of anti-Stokes lines with the nature of the absorption spectrum. A detailed examination of the absorption spectrum has revealed new bands. The action of oxygen and nitrogen on the absorption appears to be chiefly

on the transitions with $v'' = 0$. An analysis of the hyperfine structure shows that this effect is due to widening of the absorption lines. This widening enables the sphere of action of iodine molecules to be calculated and permits the application of Heisenberg's principle to the calculation of the mean life of an excited state. It would appear that the chief effect of foreign gases is on the molecules in an excited state, a result which also follows from a consideration of the Condon parabola. A connection has also been established between the widening of the absorption lines and the depolarisation of the resonance rays. By means of an echelon some of the fluorescent rays excited by the Hg line 5461 have been photographed and the results have established the identity of the transitions $3\pi_o^+ \rightleftharpoons 1\Sigma_g^+$. From this part of the work it appears that the form of line depends on the initial state if that is excited. That is, a resonance line associated with a normal and an excited state is more affected than the corresponding absorption line. The same is true with regard to the effect of a magnetic field.

J. E.

***327. Resonance Spectrum of Selenium.** S. Gawroński. *J. de Physique et le Radium*, 5. pp. 533-534, Oct., 1934.—It is shown that the very complicated resonance spectrum of Se excited by the Hg lines 4359 Å and 4047 Å is independent of the broadness of the lines, and of the temperature of the vapour. A specially constructed Hg-vapour lamp, which ran very cool and which consequently gave very fine spectrum lines, was used. It is suggested that the complexity of the spectrum is due to the large number of isotopes of Se.

D. H. F.

328. Effect of Nitrogen on Selenium Fluorescence Spectrum. S. Gawroński. *J. de Physique et le Radium*, 5. pp. 535-537, Oct., 1934.—It is shown that the fluorescence spectrum of Se excited by the Hg-lines 4359 Å and 4047 Å is strongly modified by the addition of nitrogen to the Se vapour. As the pressure of nitrogen is increased, the complex series of multiplets in the spectrum disappears, leaving only the characteristic pair of doublets, whose intensity is hardly affected, and a continuous spectrum.

D. H. F.

329. Fluorescence of Helium and Collisions of the Second Kind by Excited Helium Atoms. W. Maurer and R. Wolf. *Zeits. f. Physik*, 92. 1-2. pp. 100-115, Nov. 2, 1934.—The ultra-violet He-series ($n^1P_1 - 1^1S_0$) is produced by electron bombardment of helium and investigations are made upon the fluorescence resulting from its absorption. In addition to expected lines, the spectrum of this fluorescence contains triplet lines, the appearance of which is attributed to the occurrence of collisions of the second kind, viz. $\text{He } (n^1P_1) + \text{He } (1^1S_0) \rightarrow \text{He } (1^1S_0) + \text{He } (n^3D)$ [see Abstract 4991 (1932)]. In accordance with expectation the number of these collisions falls off with decrease of pressure.

L. A. W.

330. Intensities of Raman Lines. K. Haberl. *Ann. d. Physik*, 21. 3. pp. 285-300, Nov., 1934.—The intensities of the Raman band of cyclohexane with maxima at 2835, 2920 and 2953 cm^{-1} excited by the Hg-lines 3132, 3022, 2967, 2894 and 2652 Å are measured by a photographic method. The intensities of the exciting lines are also determined. The comparison source of known spectral intensity distribution is the positive crater of a pure carbon arc at 3700° Abs. The dependence of the observed intensities of the Raman bands upon the frequency of the exciting lines is in agreement with Placzek's theory, provided that the value of the absorption frequency occurring in the formula be taken as 53000 cm^{-1} .

Actually, however, cyclohexane vapour does not absorb until 57000 cm^{-1} , so that the intensity of the Raman bands increases more rapidly with the frequency of the exciting line than is required by the theory. L. A. W.

331. Raman Effect in Electrolytes. L. Simons. *Soc. Scienc. Fennica, Comm. Phys. Math.* 7. 9. [24 pp.], 1934. *In German.*—Raman spectra are reported of six solutions of nitrates (nitrates of Na, K, NH_4 , Ca, Cd, Pb), two solutions of sulphates (ammonium and cadmium) and nitric and sulphuric acids, all in different concentrations and observed under the same experimental conditions. The variations of intensity with concentration of the strongest lines is measured. From observations on the salt solutions it is deduced that the ions alone give rise to Raman lines, and that their intensities are proportional to the concentrations. From this it is concluded that these salts are completely ionised in solution, whatever the concentration. In the solutions of acids it is otherwise; the lines due to ions decrease in intensity out of proportion to the concentration, agreeing with a progressive dissociation as dilution proceeds. Sulphuric acid dissociates in two stages, and this is followed quantitatively.

A. C. M.

332. Raman Effect of the Nitrite Ion. A. Langseth and E. Walles. *Zeits. f. phys. Chem.* 27. Abt. B. 3-4. pp. 209-218, 1934.—The relative intensities and states of polarisation are determined for the three strong Raman lines of the nitrite ion, using a saturated solution of NaNO_2 at 20°C . Lines are found having the following frequencies in cm^{-1} , relative intensities, and depolarisations respectively; 1331, 1240, 813; 12.9, 2.4, 1.0; 0.43, 0.84, 0.21. It is concluded that this ion has

the constitution $\text{—N} < \begin{array}{c} \text{O} \\ | \\ \text{O} \end{array}$ A. C. M.

333. Raman Spectrum of Stannic Chloride. J. Guéron. *Comptes Rendus*, 199. pp. 945-948, Nov. 5, 1934.—A fresh solution of stannic chloride gives rise to three Raman lines, which coincide with those of the ion SnCl_6^{--} . It is suggested that by the dissociation of these ions into Sn^{++} and Cl^- and the subsequent formation of SnO_2 , XH_2O , the formation of colloidal suspensions in such solutions can be explained. A. C. M.

334. Raman Spectra of Tartaric Acid and Tartrates. I. Peychès. *Comptes Rendus*, 199. pp. 1121-1123, Nov. 19, 1934.—Variations in rotatory power of the tartrates with concentration may be attributable in part to the deformation of the ion due to the rest of the ions. This should mean that there would be an effect on the Raman spectra of the ions involved. Observations were made on six alkaline tartrates, all of $2M$ concentration, and on tartaric acid and pure ethyl tartrate. The frequency 1750 cm^{-1} attributed to the radical $\text{C}=\text{O}$ present in the spectra of the two last substances mentioned is replaced in the spectra of the rest by a frequency at about 1620 cm^{-1} . The lines at about 1400 cm^{-1} in the ionised tartrates are much stronger than in the non-ionised tartaric acid and ethyl tartrate. Also their values pass through a maximum at ammonium tartrate in the series Li, Na, NH_4 , K, Rb, Cs, just as the rotatory power-concentration curve for the ammonium tartrate, lies between the curves for the tartrates of heavier and tartrates of lighter alkali metals. A. C. M.

***335. Raman Effect of Acetylenes. Part I. G. Glockler and H. M. Davis.** *J. Chem. Phys.* 2. pp. 881-889, Dec., 1934.—An improved helical discharge tube containing neon and mercury with a saturated solution of sodium nitrite as filter served as a monochromatic source of radiation

(4358 Hg). A mechanical filter avoided over-exposure of the exciting radiation. The vibration frequencies were studied on the basis of the symmetry properties of the molecules and the usual assignments have been made. Faint rotation lines were found accompanying the C : C vibration in liquid dimethyl-acetylene. They are interpreted as rotation of the six H atoms round the figure axis of the molecule. The moment of inertia is $I = 10^{-39} \text{ gm.} \times \text{cm}^2$. The three compounds were studied in the liquid state. AUTHOR.

***336. Light Intensity in Spectral Apparatus, Spectrographs and Monochromators.** C. Leiss. *Zeits. f. Physik*, 91. 11–12. pp. 816–817, Oct. 23, 1934.—Attention is drawn to a publication by Schulz [see Abstract 2059 (1934)] in which a monochromator having an $f1.0$ collimator lens is described. This paper is considered by the author to give the impression that the aperture of the collimator determines the intensity of illumination provided by the monochromator. It is pointed out that this impression is erroneous and that the aperture of the telescope determines the intensity output of a monochromator or similar spectral apparatus. Arguments are given to show that the use of a large-apertured collimator lens is more often disadvantageous than profitable. J. E. K.

***337. Grating Microspectrograph and Its Application to Micro-chemistry.** E. E. Jelley. *Phot. J.* 74. pp. 514–521, Nov., 1934. *Comm. No. H533 from the Kodak Research Lab.*—A grating microspectrograph is described in which the direct image of the slit falls on a viewing screen in order to facilitate adjustments when work is being done at high magnification. The use of the instrument for the determination of optic axial angles of biaxial crystals is discussed. A new technique of micro-identification of organic substances is described, which depends on the production of characteristic birefringence spectrograms of wedge-shaped crystals obtained by fusion of the unknown, and of known substances having approximately the same melting point. A. H.

338. Spectrum Analysis in the Service of Industry. W. Gerlach. *Zeits. f. techn. Physik*, 15. 11. pp. 451–453, 1934.—Considerations of the processes taking place in the light source indicate the high tension arc as most suitable for chemical analyses. It allows of the chemical spectrum analysis of metals, salts, precipitates, etc. Its use in the solution of technical problems is illustrated by three new examples: the distribution of iron in zinc and of calcium in other pure metals; the local detection of iron in gold-silver alloys; examination of geological specimens. C. B. A.

339. Analysis of Industrial Materials by Flame Spectra. F. Waibel. *Zeits. f. techn. Physik*, 15. 11. pp. 454–456, 1934.—The possibilities of the flame spectrum method of analysis are discussed from the points of view of sensitivity and accuracy, and illustrated by examples from analyses of metals, alloys, minerals, glasses, etc. The applicability of the method is compared with that of the spark method. C. B. A.

340. Detection of the Alkali Metals by the Arc Spectrum Method. P. Urbain and M. Wada. *Comptes Rendus*, 199. pp. 1199–1201, Nov. 26, 1934.—A method of detecting the alkali metals using the arc spectrum is described. A relationship can be established graphically between intensities of the characteristic lines and the quantities of metal volatilised. The limits of sensitivity are determined and are found to be lower than those of the flame and spark spectra. C. B. A.

341. Calculation of Free Energies, Entropies, Specific Heats and Equilibria from Spectroscopic Data : Validity of the Nernst Heat Theorem. H. Zeise. *Zeits. f. Elektrochem.* 40. pp. 885-890, Dec., 1934.—A general review is continued [see Abstract 4598 (1934)]. A tabular summary is given of the results of the calculations of different workers upon the following homogeneous gas equilibria: $O_2 \rightleftharpoons 2O$, $H_2 \rightleftharpoons 2H$, $D_2 \rightleftharpoons 2D$, $HD \rightleftharpoons H + D$, $N_2 \rightleftharpoons 2N$, $NO \rightleftharpoons N + O$, $\frac{1}{2}N_2 + \frac{1}{2}O_2 \rightleftharpoons NO$, $Cl_2 \rightleftharpoons 2Cl$, $\frac{1}{2}Cl_2 + \frac{1}{2}H_2 \rightleftharpoons HCl$, $Br_2 \rightleftharpoons 2Br$, $\frac{1}{2}H_2 + \frac{1}{2}Br_2 \rightleftharpoons HBr$, $I_2 \rightleftharpoons 2I$, $\frac{1}{2}H_2 + \frac{1}{2}I_2 \rightleftharpoons HI$, $\frac{1}{2}I_2 + \frac{1}{2}Cl_2 \rightleftharpoons ICl$, $P_2 \rightleftharpoons 2P$, $S_2 \rightleftharpoons 2S$, $\frac{1}{2}S_2 + \frac{1}{2}O_2 \rightleftharpoons SO$, $H_2 + \frac{1}{2}O_2 \rightleftharpoons H_2O$, $\frac{1}{2}H_2 + OH \rightleftharpoons H_2O$, $2CO_2 \rightleftharpoons 2CO + O_2$, $C + CO_2 \rightleftharpoons 2CO$, $CO_2 + H_2 \rightleftharpoons CO + H_2O$, $N_2 + \frac{1}{2}O_2 \rightleftharpoons N_2O$, $\frac{1}{2}S_2 + H_2 \rightleftharpoons H_2S$, $\frac{1}{2}S_2 + O_2 \rightleftharpoons SO_2$, $C_2H_4 + H_2 \rightleftharpoons C_2H_6$. Some additions to the previous parts are also appended. L. A. W.

See also Abstracts 58, 156, 195, 236, 240, 246, 251, 259, 264, 266, 375, 378, 449, 491, 492.

VELOCITY OF LIGHT.

342. Velocity of Light from Stellar Radial Velocity. P. Salet and Camichel. *Bull. Astronomique*, 8. 7. pp. 385-402, 1933.—The variation of observed radial velocity during the year has been used to determine the solar parallax. The method may be reversed to give the velocity of light. Its accuracy is not great but the astronomical determinations of the velocity of light differ by as much as 1 % from physical methods. The necessary formulæ for all stars are derived and the case of a double star is discussed. Sources of error are detailed; many effect all the data for a particular star uniformly. Paris plates of α Persei have been specially measured. The case of Arcturus is discussed. Most of the data are derived from the Lick observations. The authors conclude that the velocity of light derived by this method varies with the spectral type of the star observed. There is a fairly close agreement between their results and the variations of the constant of aberration found by Becker using a quite independent method. The authors reserve judgment as to the reality of the effect; the number of observations of stars far from opposition is still too small.

T. L. M.

343. Velocity of Light. R. T. Birge. *Nature*, 134. pp. 771-772, Nov. 17, 1934.—It has been shown by Edmondson that the values of the velocity of light, determined during the period 1875-1934 by the use of long base-line methods, are accurately represented by the formula

$$c = 299,885 + 115 \sin(2\pi/40)(t - 1901) \text{ km./sec.}$$

The author points out that no such fluctuation in the value of c is found if the results of indirect measurements, with compact apparatus, are used. Thus any variations must either be instrumental or, if not, must be due to the fact that every atomic frequency is changing, in terms of the mean solar day. Rejecting the latter hypothesis as improbable and unverifiable, the author adopts the constant value for c of $299,776 \pm 4$ km./sec.

G. C. McV.

VISION.

344. Analysis of Glare. J. F. Schouten. *K. Akad. Amsterdam, Proc.* 37. 8. pp. 506-516, 1934. *In German*.—The glare from a light source at various angles ϕ from the direction of view was studied by determining the minimum brightness H of a square test object on a dark background such that the square form could just be recognised using foveal vision. Increasing ϕ keeping the distance and candle power of the glare source

constant, H first decreased rapidly ($\phi = 5^\circ$ to 25°), and then quite slowly ($\phi = 25^\circ$ to 85°), never actually reaching the no-glare value. A differentiation is made between glare due to light passing through the eye pupil and that due to light transmitted by the sclerotic. By confining the glare illumination (a) to the cornea (b) to the sclerotic, the amounts of these two contributions to the glare were determined separately. The scleral illumination is important for large glare angles ϕ and at $\phi = 25^\circ$ contributes between 30 and 60 % of the total glare effect depending on the colour of the glare light, the percentage being highest for red light. The possibility of colour distortion as a result of the scleral glare light is indicated. W. S. S.

345. Spectral Transmission of the Sclerotic. J. F. Schouten. *K. Akad. Amsterdam, Proc.* 37. 8. pp. 516-520, 1934. *In German.*—By focussing the exit slit of a monochromator on to the sclerotic of an observer's eye, the observer's field of view was suffused by an approximately uniform brightness of monochromatic light due to rays which had penetrated the sclerotic. By means of a sector disc, it was arranged for the light from the monochromator to be intercepted periodically and redirected to illuminate an opal glass placed in front and close to the observer's pupil. An absorbing wedge placed in one of the alternative light paths, enabled the observer to match the brightness of the opal with the brightness seen entoptically. The relative values of the transmission of the sclerotic for different wave-lengths were determined. The transmission curve obtained resembles that of oxyhæmoglobin. Several interesting entoptic effects were observed in the experiments. W. S. S.

346. Additive Effects of the Two Eyes in the Observation of Targets. Use of Yellow Light. A. Blondel. *Rev. d'Optique*, 13. pp. 247-250, Aug., 1934.—The author suggests that where investigators have found visual acuity or the visibility of point sources no better for binocular vision than for monocular vision, the two eyes have not been properly corrected for accommodation errors. Experiments by Ferree, Rand and Lewis and the author's own observations, are quoted in support of this view. Attention is drawn to the author's advocacy of yellow light for searchlights (for reasons based on Rayleigh's law), which appeared in a publication of 1914. W. S. S.

347. Flicker Relations within the Fovea. F. A. Geldard. *J.O.S.A.* 24. pp. 299-302, Nov., 1934.—One half of a circular field of 1° dia. was maintained dark or at a fixed brightness ranging from 3 to 500 ml., whilst the critical frequency for disappearance of flicker in the other half of the field was determined for a subject who fixated on the centre point of the combined field. The average brightness of the flickering half-field equalled 97 millilamberts throughout (all brightnesses being of white light). With all values of the fixed field brightness the flicker frequency was higher than when the fixed field was kept dark. The change in frequency was of the order of 4 %, but variation with the fixed field brightness in the range studied, was observed. The experiment is interpreted as establishing that facilitation, not inhibition, results from intrafoveal interaction. W. S. S.

***348. Visual Thresholdometer. M. Luckiesh and F. K. Moss.** *J.O.S.A.* 24. pp. 305-307, Nov., 1934.—The instrument consists of a spectacle frame fitted with artificial pupils in front of each of which an annular wedge of photographic film can be rotated so that the amount of light

admitted is variable from 80 % to less than 2 %. The two wedges are rotated together "in phase" by a knob, operated by the observer who sets the instrument so that a given visual task is on the threshold of performance. The wedges, owing to their diffusing properties, modify both the relative and the absolute values of brightnesses in the field of view.

W. S. S.

X-RAYS.

349. Nature and Origin of the Radiation from Semi-Conducting Cells. G. Déchéne. *J. de Physique et le Radium*, 5. pp. 553-562, Nov., 1934.—The nature and origin of the electromagnetic radiation emitted at one of the electrodes conveying current to a semi-conductor are investigated [see Abstract 2921 (1934)]. The ionising radiations emitted are found to lie within a range of about 10 to several hundred Å, and originate in a thin layer of air in contact with the semi-conductor. J. S. G. T.

350. Influence of Anode Temperature on Emission of X-Rays. F. Halla and H. Nowotny. *Zeits. f. Physik*, 92. 1-2. pp. 76-81, Nov. 2, 1934.—It is shown experimentally by measuring the emissivity by an ionisation method, the current strength in the X-ray tube being kept constant, that variation of the temperature of the cathode causes variation in the emission of X-rays, the emission increasing at the higher temperatures. As a possible cause of this variation with temperature the increased electronic reflection at the lower temperatures is discussed. H. L. B.

351. Diffuse Scattering of X-Rays from Sylvine. G. E. M. Jauncey and W. D. Claus. *Phys. Rev.* 46. pp. 941-945, Dec. 1, 1934.—Harvey's S values for sylvine at 295° K. [see Abstract 3056 (1933)] agree qualitatively with the theoretical S values calculated from James and Brindley's quantum-mechanical f and E_{jj} values. Quantitatively, the difference between experiment and theory is too great for comfort. A more exact and careful determination of the experimental S values has led to a remarkable agreement between experiment and theory. This shows the excellence of the present theory of diffuse scattering and the accuracy of the f and E_{jj} values which James and Brindley have calculated by approximate methods. The results are not in accord with the idea that the probability distribution is the same for all electrons. Experiments has shown that turning the crystal plate in its own plane has no effect on the diffuse scattering in a given direction. This indicates that the atoms of sylvine possess spherical symmetry as far as the scattering of X-rays is concerned. Spherical symmetry is assumed in the theory.

AUTHORS.

352. Relation of Refraction Index of X-Rays to Angle of Incidence. F. Jentzsch and H. Steps. *Zeits. f. Physik*, 91. 3-4. pp. 151-166, Oct. 2, 1934.—The Ketteler equations for this phenomenon in absorbing media are discussed. The author traverses the opinion that the simple refraction equation, to which Ketteler's reduce for zero absorption, can be used where the absorption is slight. Especially close to the limiting angle of total reflection the formulæ for absorbing media must always be used. They are here put in a form for use when the index of refraction is near unity. The greatest deflection does not then occur for glancing incidence. The angles of greatest deflection are found. This has been tested for incidence of X-rays on glass. T. L. M.

353. Reflection of X-Rays from Powdered Anthracene. B. W. Robinson. *Roy. Soc., Proc.* 147A. pp. 467-478, Dec. 1, 1934.—Previous measurements by the author [see Abstract 5352 (1933)] of the F(001) value for single crystals of anthracene showed a discrepancy between the values obtained with two different X-ray wave-lengths. Measurements with powdered crystals are more satisfactory in that absorption and extinction effects can be accurately estimated; the technique of making such measurements with anthracene is described, and the results give the same value for either wave-length, the value being somewhat higher than that previously found (34.3 as against 30.5 and 32.8). AUTHOR.

354. $K\alpha$ Lines of Carbon and Carbon Compounds. H. Broili, R. Glocker and H. Kiessig. *Zeits. f. Physik*, 92. 1-2. pp. 27-41, Nov. 2, 1934.—The carbon $K\alpha$ line is observed in the cases of graphite, diamond and several carbides. Up to four components are found. Substances having similar lattices give carbon lines possessing similar fine-structures. The breadth of the $K\alpha$ line is found to depend on the energy of lattice binding. The broadest line is found in the case of the pure element. Introduction of foreign atoms sharpens the line. The bigger the coordination number and the difference in atomic number between carbon and the foreign atom, the narrower does the $K\alpha$ line become. J. T.

355. X-Ray Levels and Atomic Constants. H. R. Robinson. *Phil. Mag.* 18. pp. 1086-1099, Dec., 1934.—A number of the X-ray levels of Au, Pt, W, Sn, Ag and Cu have been investigated with the magnetic spectrometer, using Cu $K\alpha$ and Cr $K\alpha$ radiations in turn. There are some anomalies which require closer examination, but on the whole the results are remarkably consistent, and they lead to fairly definite indications of the most probable values of the atomic constants and of X-ray wave-lengths. [See Abstract 4745 (1934).] AUTHOR.

***356. Industrial Radiography.** E. W. Hall and J. W. Davies. *Electrician*, 113. pp. 693-696, Nov. 30, 1934.—An account is given of the X-ray apparatus employed by the M-O Valve Co., and examples are given of its use in the examination of valves, insulators, arc lamp carbons, etc. J. T.

See also Abstracts 23, 76, 127, 220, 274.

HEAT.

CALORIMETRY.

357. Specific Heats of Cerium and Chromium. F. M. Jaeger and E. Rosenbohm. *K. Akad. Amsterdam, Proc.* 37. 8. pp. 489-497, 1934.—Measurements of the specific heat of Ce in the range 300 to 560° C. showed that no constant and reproducible value at a given temperature could be obtained. Preliminary and repeated heatings at temperatures above 360° tended to increase the specific heat, lower values being obtained by maintaining the sample at room-temperature for one or more days. The existence of two or more allotropes is indicated but with no precise transition temperature. Generally similar observations are reported for Cr. W. S. S.

358. Temperature Variation of Specific Heat of Nickel. E. Ahrens. *Ann. d. Physik*, 21. 2. pp. 169-181, Oct., 1934.—A comparative method is described for the measurement of the specific heat of metal wires to high temperatures, which employs electrical heating and small temperature increments. The method is shown to give results for Pt which agree with existing data, and is subsequently applied to two specimens of Ni. The range of these experiments is from 20 to 460° C. and particular attention is given to the changes which occur near the Curie point. Values of the electrical resistance are also derived from the experimental data. The results are compared with those of earlier investigators and the changes in specific heat and electrical resistance with temperature are discussed. The specific heat is not appreciably influenced by an external magnetic field of 550 gauss. R. W. P.

See also Abstract 374.

CONDUCTION.

359. Effect of Free Electrons on the Thermal Conductivity of Silver Sulphide. B. M. Hochberg. *Phys. Zeits. d. Sowjetunion*, 6. 3. pp. 193-204, 1934. *In German.*—A twofold increase in the thermal conductivity is observed when β -Ag₂S changes into α -Ag₂S. This increase is explained by the appearance of a great number of free electrons in the α modification; this is in agreement with the explanation put forward by Wagner [see Abstract 3170 (1933)] for the large electrical conductivity of this modification of α -Ag₂S. Since the coefficient of thermal conductivity may be considered as being made up of two contributions, that due to the atoms and that due to the electrons the magnitude of the electrical conductivity of the modification can be fixed; this is in good agreement with that calculated from the Wiedemann-Franz law. Control experiments which were made with AgI, where a change of thermal conductivity does not occur, showed that the change in the case of Ag₂S could not be attributed to change of crystal structure consequent upon the change of modification. The method of measurement is described. R. L.

360. Solutions of Problems in Heat Conduction by the Method of Wave-Trains. J. Robertson. *Phil. Mag.* 18. pp. 1009-1022, Nov., 1934. *Supplement.*—This forms a continuation of earlier papers [see Abstract 3789 (1934)] in which solutions of various problems in heat

conduction are derived by the wave-train method. The problems now dealt with include those of radial heat flow within infinitely long cylindrical rods, tubes and coaxial cylinders composed of two different materials. The last mentioned is an important case since it corresponds to that of a lagged cylinder. The source of heat is considered to be distributed on the surface of a cylindrical shell within the material, and the exterior surface is either maintained at zero, or radiates to a medium at zero temperature. Solutions are derived in the first instance for periodic sources; those for instantaneous or steady sources being derived by subsequent integration. A transformation is given by which the solutions for the analogous spherical problems may be deduced from the cylindrical.

R. W. P.

361. Thermal Resistance of Bismuth Single-Crystals at Low Temperatures. W. J. de Haas and W. H. Capel. *K. Onnes Lab. Leiden, Comm. No. 233a. Physica*, 1. pp. 929-934, Oct.-Nov., 1934. *In English*.—In a previous paper the authors [see Abstract 3791 (1934)] described a new method for the determination of the thermal resistance of metallic single-crystals at low temperatures and gave the results of measurements of the thermal resistance of Bi single-crystals in a direction parallel to the trigonal principal axis. The measurements have now been extended to the principal directions perpendicular to this axis, namely the direction of a binary axis and the direction of a bissectrix between two binary axes. The measurements were made at 81.5° K. and at a temperature between 20° K. and 16.5° K. For the direction perpendicular to the principal axis the thermal resistance-temperature curve shows a minimum, which is not the case for the direction parallel to the principal axis down to 16.5° K. These results are discussed and details are given of the method of preparing the crystals.

R. L.

CONVECTION.

362. Natural Convection at High Pressures. O. A. Saunders. *Engineering*, 138. p. 436, Oct. 26, 1934. *Paper read before the British Assoc., Aberdeen, Sept., 1934*.—Instead of experimentally determining the loss of heat by natural convection from a number of surfaces of the same shape but differing in size, the author suggests that experiments could be carried out on one experimental hot body subjected to a range of pressures. From considerations of the principle of similitude a pressure variation of from 1 to 100 atmospheres is shown to be equivalent to a 22-fold increase in the dimensions. Experimental results are given for a horizontal wire heated in N_2 at pressures up to 680 atmospheres, and reference is also made to existing results of Petavel. They show fair agreement with the average values given by experiments on cylinders of various sizes at atmospheric pressure. For pressures above 100 atmospheres the effect of pressure on the various physical constants of the gas becomes uncertain.

R. W. P.

363. Newton's Law of Cooling in Microcalorimetry. W. Swietoslawski and J. Salcewicz. *Comptes Rendus*, 199. pp. 935-937, Nov. 5, 1934.—The case discussed is that of a body which is steadily generating a minute quantity of heat. Some experimental results on pitchblende are given.

L. G. C.

See also Abstract 371.

DILATATION.

364. Expansion of Specimens of Silica-Sodium-Aluminium Glass. E. Rencker. *Comptes Rendus*, 199. pp. 1114-1116, Nov. 19, 1934.—Triangular diagrams for transformation temperatures and expansion coefficients are given, and show that progressive substitution of Na_2O and SiO_2 by Al_2O_3 up to 50 % Al_2O_3 raises the temperature of softening, a transformation temperature of 800° being attained. The curves for equal expansion show that Schott's additivity law is obeyed only approximately. Substitution of Na_2O by Al_2O_3 lowers the expansion; replacement of SiO_2 produces a smaller similar effect except for a small region in which Al_2O_3 in excess of 20 % causes increased expansion [see Abstract 1428 (1934)]. N. M. B.

365. Thermal Expansion and Ferromagnetic Change in Volume of Nickel. C. Williams. *Phys. Rev.* 46. pp. 1011-1014, Dec. 1, 1934.—The coefficient of thermal expansion is measured at intervals of 2.5°C . between 200°C . and 500°C . for single and polycrystalline specimens of nickel of varying known degrees of purity. The data yield the value $3.24 \pm 0.15 \times 10^{-4}$ for the ferromagnetic change in volume per unit volume of pure nickel. AUTHOR.

366. Analysis of Thermal Stresses in Sealed Cylinders and the Effect of Viscous Flow During Annealing. H. Poritsky. *Physics*, 5. pp. 406-411, Dec., 1934.—Equations are derived for the thermal stresses in long sealed cylinders due to different coefficients of expansion, on the basis that the material of the cylinder is elastic. The optical retardation due to this stress distribution is computed for a ray travelling normal to the axis, and is found to depend upon the axial stress only. The modification in the stress distribution is then investigated for the case when plastic or viscous flow takes place during annealing. AUTHOR.

***367. Glass-to-Metal Seals.** A. W. Hull and E. E. Burger. *Physics*, 5. pp. 384-405, Dec., 1934.—The problems of sealing are adhesion and strain. The simplest, but perhaps not the only means of adhesion is a firm layer of metal oxide. Strains can be avoided if, and only if the thermal expansions of metal and glass are the same. This postulate is thoroughly tested. Equations are derived for the stresses in cylindrical seals, in terms of the difference in expansion of metal and glass, and the stresses thus calculated are compared with those observed photoelastically in carefully annealed test seals. Such tests are carried out on all the important sealing materials. These tests include accurate contraction coefficient measurements of glass and metals; graphical exhibition of axial stresses by photographs through crossed nicols and a quartz wedge; and numerical evaluation of all the stresses, both theoretical and experimental. Two new sealing alloys are described: fernichrome (Fe 37 per cent, Ni 30 per cent, Co 25 per cent, Cr 8 per cent) which matches standard lead glass; and fernico (Fe 54 per cent, Ni, 28 per cent, Co 18 per cent) which matches Corning glasses G-71 and G-705 A O. The unique feature of these alloys is that their expansion characteristics are curved in such a manner that they match those of the glasses mentioned with considerable fidelity. The seals made with these combinations are found to be practically free from strain. AUTHORS.

MELTING AND BOILING POINTS.

368. Freezing Points of Aqueous Solutions. Part VIII. Mixtures of Sodium Chloride with Glycine and Ethyl Alcohol. G. Scatchard and S. S. Prentiss. *Am. Chem. Soc., J.* 56. pp. 2314-2319, Nov., 1934.—The analytical expression of the thermodynamic functions of dilute solutions is extended to solutions containing ions. The freezing point depressions of mixed aqueous solutions of sodium chloride with glycine and ethyl alcohol are measured and treated by this method. The results are compared with the measurements of other properties of these solutions and with theoretical calculations. [For Part VII see Abstract 3801 (1934).]

AUTHORS.

369. Freezing Points of Aqueous Solutions. Part IX. Mixtures of the Reciprocal Salt Pair: Potassium Nitrate-Lithium Chloride. G. Scatchard and S. S. Prentiss. *Am. Chem. Soc., J.* 56. pp. 2320-2326, Nov., 1934.—Measurements are made of the freezing point depressions up to one molal of the five possible equimolal mixtures of the reciprocal salt pair: potassium nitrate-lithium chloride, and of two three to one mixtures. The results of Brönsted's theory of the specific interaction of ions are derived more simply and are extended to the coefficients of the higher powers of the concentration. The parameters necessary to determine the thermodynamic functions of any mixture of this reciprocal salt pair are determined and found to agree completely with the extended theory of Brönsted. Some of the consequences of this agreement are discussed. [See preceding Abstract.]

AUTHORS.

370. Solidification Diagrams for Alloys of Two Alkali Metals: Na and Cs. E. Rinck. *Comptes Rendus*, 199. pp. 1217-1219, Nov. 26, 1934.—A thermal analysis of a mixture of Na and Cs is made and the solidification diagram obtained. It is characterised by a eutectic point at -30°C . for 75 % Cs and a transition point at -8°C . for 71 atomic % Cs, Na_2Cs , existing between these points. Molecular magnitudes in several binary alkali systems are also discussed.

R. W. P.

371. Laws of Evaporation. Missenard-Quint. *Comptes Rendus*, 199. pp. 1023-1024, Nov. 12, 1934.—The rate of evaporation can be represented by $\beta(F - f)/(H - F)$, where H is the atmospheric pressure, F the vapour pressure at the surface and f that of the surrounding air. β is a coefficient depending on the air movement relative to the surface, and therefore on the form and dimensions of the latter. It is found that $\beta = a\rho/C_p$ where ρ is the density of the vapour, C_p the specific heat of the atmosphere at constant pressure, and a the coefficient of heat transfer by convection. The rate of evaporation can thus be deduced from a knowledge of the coefficient of convection.

R. W. P.

372. Velocity of Evaporation of Small Drops in a Gaseous Atmosphere. N. Fuchs. *Phys. Zeits. d. Sowjetunion*, 6. 3. pp. 224-243, 1934. *In German*.—The rate of evaporation of fluid drops under different conditions is calculated theoretically, account being taken of a number of factors which had been neglected in the theory of Maxwell. The chief assumptions made are that the drops are spherical and are stationary relative to an atmosphere of infinite extent, that the vapour pressure of the fluid is negligible in comparison with the atmospheric pressure, that the vapour immediately surrounding the drop is saturated and that evaporation does not cause lowering of the temperature

of the drop. Small corrections are derived which may be applied to the Maxwell theory to allow for the various factors mentioned. H. J. H. S.

See also Abstracts 72, 455.

TEMPERATURE, MEASUREMENT OF.

***373. Sensitivity of Thermopiles, Microradiometers, Radiometers and Bolometers.** C. H. Cartwright. *Zeits. f. Physik*, 92. 3-4. pp. 153-171, Nov. 12, 1934.—A detailed account of a theoretical and experimental investigation of the comparative sensitivities of these instruments for purposes of measuring radiation, taking into account disturbances due to Brownian motion, is presented. It is shown that thermopiles can be constructed with a sensitivity exceeding that of either radiometers, or microradiometers used in air, and equal to that of vacuum microradiometers and vacuum bolometers. The best vacuum thermopiles, using bismuth alloys in their construction, are only twice as sensitive as iron-constantan thermopiles constructed in accordance with an improved technique. Thermodynamic considerations suggest a five-fold increase of sensitivity of thermopiles, constructed of ideal thermoelectric metals and used at room-temperatures. J. S. G. T.

See also Abstract 422.

THERMOCHEMISTRY.

***374. Heats of Solution and Heats of Reaction in Liquid Ammonia.** Part III. C. A. Kraus and F. C. Schmidt. *Am. Chem. Soc., J.* 56. pp. 2297-2300, Nov., 1934.—Improvements in the construction and in the technique of manipulation of the liquid ammonia calorimeter are described. Heats of solution are reported for a number of substances, in some cases over a range of concentration. Sodium bromide has a marked heat of dilution. Energies of reduction are reported for trimethyltin bromide to trimethyltin and to sodium trimethylstannide. From these are calculated the energies of bromination of trimethyltin and reduction of trimethyltin to the corresponding negative ion. [For Parts I and II see Abstract 1227 (1934).] AUTHORS.

375. Optical Determination of Heats of Dissociation of Molecular Compounds (AB_2). G. Briegleb and J. Kambeitz. *Zeits. f. phys. Chem.* 27. *Abt. B.* 3-4. pp. 161-175, 1934.—The conditions are first accurately described which enable an optical determination of heats of dissociation. Under consideration of the two equilibria, $AB_2 = AB + B$ and $AB = A + B$, relationships are established for which, in principle, data are required before the optical method can be employed. Experimental work is included for molecular compounds of trinitrobenzene with stilbene, 1:4-diphenylbutadiene, 1:4-diphenylbutene, 1:6-diphenylhexadiene, tolane and dibenzyl. A theoretical discussion is given of the transformations. H. H. Ho.

376. Heats of Formation of Ammonia and Nitric Acid. G. Becker and W. A. Roth. *Zeits. f. Elektrochem.* 40. pp. 836-843, Dec. 1, 1934.—Previous work on the heats of formation of NH_3 from its elements and of dilute HNO_3 from N_2 , O_2 and water is first discussed, following which comes a description of new work for the more exact determination of these data. The results are: For NH_3 , $+11.0, \pm 0.07$, and for HNO_3 , aq $+14.84 \pm 0.08$ k. cal. The heat of hydration of anhydrous oxalic acid is also found to be $+6.59$ k. cal. A very full discussion of the work is included. H. H. Ho.

377. Spark Ignition of the Methane-Oxygen Mixture. G. Gimmelmann and M. Neumann. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 4. pp. 35-41, Oct. 11, 1934. *In German.*—In this paper the authors investigate: (1) the efficiency of the spark itself, and conclude that spark ignition is a purely thermal process; (2) the influence of pressure, which conforms to the formula $\log p/\sqrt{CV^2} = A/\sqrt{CV^2} + B$; (3) the influence of the distance between the electrodes, which appears to be represented by the empirical expression, $CV^2/2 = 0.10 + 0.21/d^2$; (4) the effect of temperature which can be expressed by $CV^2 \cdot e^{-v/T} = \text{const.}$, where $V = 1200$. CV is the quantity of electricity. The above facts are explained by a chain mechanism in which the rôle of the spark is to create a number of active centres whose concentration is approximately proportional to CV^2 . H. H. Ho.

378. Sodium Line-Reversal Method of Determining Flame Temperatures. W. T. David. *Engineering*, 138. p. 475, Nov. 2, 1934.—Evidence that flame temperatures determined by the sodium line-reversal method may be some hundreds of degrees C. above the true values is presented, and reasons for the differences are discussed. J. S. G. T.

See also Abstracts 123, 308, 314, 318, 341, 423.

THERMODYNAMICS.

379. Properties of Real Gases Based on the Thermodynamic Equation of State. Part II. Joule Effect for Helium. W. Jacyna. *Zeits. f. Physik*, 92. 3-4. pp. 204-211, Nov. 12, 1934.—In the normal temperature zone the Joule effect, $\mu_\mu = (8t/8p)_v$, for helium converges to zero value. From -150° to 500° C. and from 0 to 100 kg./cm.² pressure, there is at every pressure for helium a temperature at which the Joule law is completely fulfilled (an inversion line of the first order). At not too low a pressure (715 atm.) and temperature ($7-73^\circ$ C.) the Joule effect for helium is negative, and continuously increases with increasing temperature. In contradiction with the van der Waals theory, the isothermal change (specific) of the internal energy $(\partial U/\partial v)_t$ is also an essentially negative quantity at not too low temperatures. Likewise the pressure dependence of the Joule effect similar to the Joule-Thomson effect occurs in the low pressure region at not too high temperatures. Based on Roebuck and Osterberg's calculations it appears (under assumption that the Joule-Thomson effect is independent of the pressure) that extreme values of μ_μ occur at higher temperatures. [For Part I see Abstract 5135 (1934).] H. H. Ho.

380. Physical Properties of the Rare Gases. E. Brander. *Soc. Scien. Fennica, Comm. Phys.-Math.* 7. 14. [8 pp.], 1934. *In English.*—The virial law of Clausius enables expressions to be derived for the constants "a" and "b" of the van der Waals equation. By means of Wasastjerna's formula for the repulsion which the atoms of the rare gases exert on one another [see Abstract 2799 (1933)] it is possible to evaluate "b." This has been done for Ne, Ar, Kr and Xe at 273.1° K. The atomic diameters (d) are calculated, and it is also shown that Sutherland's constant $S = H/3Rd^6$, where R is the usual gas constant and H an attraction constant which can be derived from the lattice intervals. R. W. P.

381. Theory of Fusion. K. F. Herzfeld and Maria G. Mayer. *Phys. Rev.* 46. pp. 995-1001, Dec. 1, 1934.—Although equilibrium between two phases is in general determined by both phases, fusion stands somewhat apart in that a crystal cannot be overheated. As a type of the

simplest possible crystal, the exact equation of state of frozen argon has been developed here. It has been found that the pressure as function of the volume at a given temperature has a minimum, which means the breakdown of the crystal under these conditions. The temperature at which this minimum occurs at zero pressure is interpreted as the melting point. It has been found in accordance with experiment that a positive pressure is necessary for the existence of crystalline helium but the numerical agreement is bad. AUTHORS.

382. Internal Equilibria in the Solid Phase. Part II. A. Smits, K. Clusius and A. Perlick. *Phys. Zeits.* 35. pp. 914-919, Nov. 15, 1934. —Clusius and Perlick's conclusion that, at -252.8° , solid methane undergoes a transition [see Abstract 1652 (1934)] which must be regarded as an Ehrenfest transition of the second order, is regarded by Smits as premature. Measurements made by a highly accurate static method on a system of the greatest purity are necessary to decide the nature of the transition. The results obtained with solid NH_4Cl [see Abstract 4970 (1933)] show what great care must be taken. On the basis of the theory of allotropy it was shown years ago that, with a solid or liquid pseudo-binary system which in the solid or liquid state exhibits a demixing line with an upper critical mixing point, it may happen that the internal equilibrium line touches the demixing line at this upper critical mixing point. The heat of transition and the isothermal change of volume are zero at this point, just as for a transition of Ehrenfest's second order. Study of the influence of pressure would probably decide between the two. Clusius and Perlick reply to these criticisms, pointing out that their investigations on methane were made on thoroughly purified material and reaffirming their faith in Ehrenfest's extension of the conception of phase. In answering this reply, Smits suggests that the purity of the methane should be tested by measuring the vapour pressures of distillate and residue after partial distillation at constant temperature. [For Part I see Abstract 3180 (1930).] T. H. P.

383. Empirical Heat Capacity Equations for Simple Gases. H. M. Spencer and J. L. Justice. *Am. Chem. Soc., J.* 56. pp. 2311-2312, Nov., 1934.—The heat capacities of equilibrium chlorine and equilibrium hydrogen chloride between 300 and 1500°K . have been calculated by use of the tables of Gordon and Barnes, and that of carbon dioxide has been calculated over the same range by use of the Planck-Einstein equation. Empirical equations of the form, $C_p = a + bT + cT^2$, have been fitted to the theoretical values of the heat capacities of the above gases and of hydrogen, oxygen, nitrogen, carbon monoxide, bromine, hydrogen bromide and water vapour, with average deviations ranging from 0.18 to 0.76%. AUTHORS.

384. Thermodynamics of Binary Liquid Mixtures: Formic Acid and Water. A. N. and Alexandra J. R. Campbell. *Faraday Soc., Trans.* 30. pp. 1109-1114, Dec., 1934.—The following physical constants of mixtures of formic acid and water have been determined at 30° and at 50° : (1) heat of mixing, (2) composition of vapour phase, (3) vapour pressure, and (4) heat of evaporation. The heat of evaporation has been calculated from the data of (1) and (2), knowing the heats of evaporation of the pure components. The vapour pressures have been calculated by means of the Clausius-Clapeyron equation, and it is suggested that the marked deviation observed here is due to the association of formic acid vapour. AUTHORS.

385. Physics of the Metallic State. F. Wever. *Zeits. f. techn. Physik*, 15. 11. pp. 418-421, 1934.—An account is given of the present position of the subject. The following branches are considered: microscopy, thermal analysis, construction of phase diagrams, X-ray analysis, the theory of alloys, the hardening of steel and the kinetics of austenite transformations and of precipitation hardening. J. T.

386. Mechanism of Division of Small Liquid Systems Which Are the Seats of Physico-Chemical Reactions. N. Rashevsky. *Physics*, 5. pp. 374-379, Dec., 1934.—In continuation of a previous investigation [see Abstract 3480 (1932)] the mechanism of division of small liquid droplets which are the sets of physico-chemical reactions, is being studied now not from thermodynamical, but from the kinetic point of view. Thermodynamical consideration derives conditions under which the whole drop is less stable than its two halves. It does not say, however, anything about the degree of stability. The present investigation makes this next step, and shows under what conditions a drop becomes so unstable that an infinitesimal deformation will lead to a division. The critical sizes calculated here are close to those calculated by thermodynamical method. The importance of "release phenomena" and "valve action" in the cases considered is pointed out. AUTHOR.

See also Abstracts 101, 190, 341, 368, 369.

VAPOUR PRESSURE.

387. Pressure of Saturated Aqueous Vapour Over Water to -50° C. L. P. Harrison. *Monthly Weather Rev.* 62. pp. 247-248, July, 1934.—Tables down to -50° C. have been prepared on the basis of relationships given by Washburn. These relationships give e_i the vapour pressure over ice at temperature t , and the e_w/e_i the relation of the pressures over water and over ice. Values of e_i are calculated for every degree and by interpolation to every 0.1° C. Similarly ratios for the e_w/e_i are found, and e_w obtained by combining the two. A table giving the values in millibars for every 0.1° C. is appended. A. E. M. G.

388. Vapour Pressures of Saturated Solutions; LiCl and Li_2SO_4 . M. P. Applebey, F. H. Crawford and K. Gordon. *Chem. Soc., J.* pp. 1665-1671, Nov., 1934.—Measurements have been made of the densities, solubilities, and vapour pressures of LiCl and Li_2SO_4 over a range of temperatures. The results indicate transition points in the case of LiCl at $19.1^{\circ} \pm 0.25^{\circ}$ C. and $93.5^{\circ} \pm 0.5^{\circ}$ C. Osmotic pressures at the boiling points under normal pressure are calculated from the Porter equation and found to be 212.9 atmospheres for Li_2SO_4 and 3050 atmospheres for LiCl, although the latter value is only an approximation on account of the high pressures involved. R. W. P.

***389. Micro-Determination of Vapour Density.** D. A. Peak and R. A. Robinson. *J. Phys. Chem.* 38. pp. 941-943, Oct., 1934.—For liquids which can be vaporised only under reduced pressure, or for liquids of high boiling point, a form of low-pressure Victor Meyer apparatus is described. The advantages are simplicity and speed of use and manipulation, avoidance of capillary tubing outside the heating jacket, and that a knowledge of the volume of the apparatus and temperature of the jacket is not required. N. M. B.

See also Abstracts 4, 72, 130, 384.

ACOUSTICS.

390. Sound Waves of Finite Amplitude. Y. Rocard. *Rev. d'Acoustique*, 3. pp. 192-197, Sept., 1934.—The author indicates how the equation of propagation of waves of finite amplitude in a conduit may be established, and considers in detail the motion in one of section defined by $S = S_0 e^{mx}$. Assuming a periodic finite vibration to be imposed at the entrance of the horn, the solution of the equation is, by a method of successive approximations, shown to involve the octave of the exciting note; the magnitude of this term is discussed. E. J. I.

391. Octave from Tuning-Forks. K. Yamashita and I. Aoki. *Kyoto Coll. Sci., Mem.* 16. pp. 367-376, Nov., 1933. *In English*.—Though the ordinary overtones of a tuning-fork do not make a harmonic series, it is known that the octave is heard when a fork is vigorously bowed and placed near a suitable resonator. The problem of how the octave is generated has been discussed by Rayleigh, E. H. Barton, and D. C. Miller. In the present paper this problem is studied experimentally and a dynamical theory is proposed to explain it. AUTHORS.

392. Sound Emitted by the Japanese "Dōhachi." I. Aoki. *Kyoto Coll. Sci., Mem.* 16. pp. 377-382, Nov., 1933. *In English*.—Records of the sound waves emitted by the Japanese bowl-shaped gong called "Dōhachi" (or "Keisu") were obtained by a Low-Hilger audiometer. They were analysed, and compared with the results found by calculation. AUTHOR.

393. Indian Musical Drums. C. V. Raman. *Indian Acad. Sci., Proc.* 1A. pp. 179-188, Oct., 1934.—It is shown that Indian musical drums have a circular drum-head which is loaded and damped in such a manner that all the overtones above the ninth are suppressed and these nine are grouped in such a manner as to give a succession of five tones in harmonic sequence. The vibrations of the drum-head present a striking analogy to the case of a stretched string giving one or the other of its first five harmonics; the drum-head divides up into 1, 2, 3, 4 or 5 sections giving the respective harmonics. The third, fourth and fifth harmonics are obtained by superposition of 2, 2 and 3 respectively of the normal modes of vibration. The corresponding superposed forms of vibration are readily obtained and demonstrated by means of sand figures. Numerous figures illustrate the paper. AUTHOR.

394. H.F. Water Jet and Ultrasonic Flame. J. J. Hopfield. *Nature*, 134. pp. 737-738, Nov. 10, 1934.—Two capillary jets of water impinge on one another from a double nozzle of glass with holes about 0.5 mm. dia. A faint h.f. note is emitted which can be made louder by blowing air on the water jet. The form and properties of the jet are described by the aid of photographs, and waves are found in it which have the respective frequencies 600 and 4200. The double nozzle when used with burning gas gives a noiseless ultrasonic flame. G. E. A.

395. Kundt's Tube with H.F. Sound Waves. O. Brandt and H. Freund. *Zeits. f. Physik*, 92. 5-6. pp. 385-389, Nov. 26, 1934.—A magnetostriction sounder was excited by the current from a valve circuit to give frequencies of 6.5, 10.6 and 25 kc in tubes of 15 to 20 mm. dia. Dust, liquids, mist and smoke were used as indicators. When liquid covers the

bottom of the tube it is shaped into wave form by vibrations of low intensity, and is gathered into heaps when high intensities are employed. When the intensity passes a critical value, the heaps are drawn upwards to form thin layers or spray. The liquids used were water, acetone, alcohol and others. Mist and smoke figures lasted only a short time due to the coalescence of the particles. By using HCl vapour and depositing it on a strip of zinc, a permanent etching of the Kundt figure was obtained. The deposition of mist or smoke takes place much more rapidly when the sounder is in action than when it is quiescent. G. E. A.

396. Motion of Stretched String in a Turbulent Flow of Air. D. Nukiyama. *Tokyo Univ. Aeronaut. Research Inst., Report No. 112. pp. 77-100, Sept., 1934. In English.*—In free air the forces due to a succession of eddies in an air stream will not be periodic and all the harmonics of the string will be evoked but with various intensities. By a lengthy calculation a relation between the intensity and frequency of a harmonic is obtained. By combining this with known loudness/frequency curves for low intensities it is deduced that a frequency in the region of 300 cycles should be heard. This is stated to be true for telegraph wires, whatever their diameter or span. J. E. R. C.

397. Path of Sound Rays in Sea-Water. K. Kitagawa. *Kyoto Coll. Sci., Mem. 16. pp. 289-295, Sept., 1933. In French.*—With normal salinity, the speed of sound in sea-water of restricted depth depends on the variation, with depth, of the temperature of the water but not of the pressure. Within a depth of 500 metres, the variation of temperature with depth is obtained from Challenger Expedition data, and linear laws of increase of compressibility and density are also found. These lead to an expression giving the speed of sound V as a function of the depth z , of the form: $V = C_0(1 - az)$. Another equation is derived which gives the path of a sound ray as parabolic, agreeing in this respect with a previous determination. [See Abstract 685 (1933).] G. E. A.

398. Measurement of Sound Velocity in Anisotropic Media. R. Bechmann. *Zeits. f. Physik, 91. 9-10. pp. 670-678, Oct. 14, 1934.*—A method of deducing the sound velocity in a medium, based upon observations of the piezoelectrically maintained vibrations of a plate of the material, is discussed. In general there will be three principal velocities corresponding to three principal directions. The method is illustrated by observations upon a suitably cut quartz plate and good agreement between calculation and measurement is obtained. J. E. R. C.

399. Velocity of Sound in Sheet Materials. A. B. Wood and F. D. Smith. *Phys. Soc., Proc. 47. pp. 149-151; Disc., 151-152, Jan. 1, 1935.*—Chladni's figures have been produced at frequencies up to 20,000 by means of magnetostrictively excited tubes or rods of nickel. The velocity of sound in sheets of brass, iron, lead, ebonite, celluloid, cardboard and other materials has been measured with considerable accuracy by this means. AUTHORS.

400. Dispersion of Supersonic Waves in a Liquid. B. Špakovskij. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S. 3. pp. 588-594, Sept. 21, 1934. In English.*—Simple theoretical considerations lead the author to deduce that dispersion of sound waves in liquids will only occur if vibratory degrees of freedom contribute appreciably to the specific heat at constant pressure. Measurements of ultrasonic wave-length are carried out using an acoustic interferometer which consists of a piezoelectric oscillator and a reflector, the frequencies of the supersonic waves generated

($2.4 \times 10^5 - 9.4 \times 10^5$ cycles) being measured by a wavemeter. Within limits of error of 1 %, no change in the velocity of propagation in water and various organic liquids could be detected. J. E. R. C.

401. Supersonic Waves and the Diffraction of Light. R. Lucas and P. Biquard, *Rev. d'Acoustique*, 3. pp. 198-212, Sept., 1934.—An ordered survey of the subject, having particular reference to the authors' work, together with a Bibliography. [See Abstracts 1145 (1933) and 2122 (1934).] E. J. I.

402. Optical Mirage Phenomena due to Elastic Waves. R. Lucas. *Comptes Rendus*, 199. pp. 1107-1108, Nov. 19, 1934.—An expression is given for the angle of refraction, α , of a narrow pencil of light passing through a medium, thickness y , subjected to longitudinal elastic vibration, wave length Λ , perpendicular to the pencil, and of velocity small compared with that of light, causing a sinusoidal variation, amplitude δn , in the index of refraction, n , of the medium, which shows that if $(2\pi y/\Lambda)\sqrt{\delta n/n}$ is < 1.6 and > 0 the amplitude of $\tan \alpha$ is proportional to that of δn and also to y , and if $> 0.8 \tan \alpha$ is a sinusoidal function of time. A method of testing the formula is suggested by subjecting the medium traversed to two mutually perpendicular sets of longitudinal vibrations. [See Abstract 4458 (1932).] C. A. S.

403. Behaviour of Suspended Particles in Air, and Velocity of Sound at Supersonic Frequencies. E. B. Pearson. *Phys. Soc., Proc.* 47. pp. 136-145; *Disc.*, 145-148, Jan. 1, 1935.—In accordance with theory, particles of the size prevailing in ordinary cigarette smoke are found to act as obstacles in air vibrating at supersonic frequencies. This action leads to the formation at the nodes in a resonance tube of figures from which measurements of the wave-length can be made. These, with a knowledge of the frequency of each piezoelectric crystal used to maintain the oscillations, enable values of the velocity of sound in air to be found at various frequencies in a range from 92.2 to 801.6 kc./sec. The values found show a definite dispersion of sound in this region, contrary to the results of previous experimenters with the Pierce acoustic interferometer. There are two maxima which are attributed to the separate effects of oxygen and nitrogen. AUTHOR.

404. Acoustics of Large Halls. J. Brillouin. *Rev. d'Acoustique*, 3. pp. 166-183, Sept., 1934.—The problems peculiar to large halls are studied and the mechanical application of the ordinary reverberation formulæ is criticised on the ground that the assumptions upon which they are based are, for such halls, ill founded. Anomalies existing during the growth of sound are of importance and in large halls energy density must be considered as a function of position as well as time. The problems are considered graphically in terms of two quantities (a) the coefficient of purity, being the fraction of the useful energy producing a sound to the total present, and (b) the fraction of the unreflected to the total energy. The influence of the position of absorbing surfaces and of sound reflectors is considered; the author advocates the employment of the latter while pointing out the dangers attendant upon their use. E. J. I.

***405. Experimental Proof of Thermophone Theory.** E. Franke. *Ann. d. Physik*, 20. 7. pp. 780-782, Sept., 1934.—In order to test the thermophone formula developed by Geffcken and Keibs [see Abstract 1982 (1933)], particularly as regards the dependence on frequency and the absolute values of sound pressures, measurements were made with a

standardised condenser microphone. The results obtained show that within the limits of experimental error the formula gives accurately both the frequency dependence and the absolute value of the sound pressure.

A. W.

406. Localisation of Pure Tones. S. S. Stevens and E. B. Newman. *Nat. Acad. Sci., Proc.* 20. pp. 593-596, Nov., 1934.—A tone can be localised in space because of a difference in intensity or in phase or in both of these factors, for the sounds reaching the two ears. For pure tones of high frequency, the intensity difference may be expected to be most effective, the phase difference indication being ambiguous. For low frequencies, diffraction effects largely vitiate the intensity difference clue, but the phase difference gives a unique indication. In accordance with this view of the matter, the average localisation error when plotted against frequency (50 to 10,000 cycles) is found in the present experiments to exhibit a maximum at about 3000 cycles, which is associated with the transition from phase difference to intensity difference localisation.

W. S. S.

407. Minimum Perceptible Change of Intensity of a Pure Tone. B. G. Churcher, A. J. King and H. Davies. *Phil. Mag.* 18. pp. 927-939, Nov., 1934. *Supplement*.—The investigation was confined to an 800 cycle pure tone, and four subjects were used, all experienced in acoustical measurements. The test tone was produced in a single or double telephone receiver in a room lined with absorbent material. The intensities employed were, 10, 20, 30, 50, 70 and 90 db above threshold, and the minimum perceptible discrete increments and decrements at these intensities were measured for one ear. At all intensities the ear is more sensitive to incremental than to decremental changes. With intensities as given above, the changes varied from about 2.5 db to about 0.75 db. Tests were also made on one and two ears using a cyclically varying intensity, and somewhat similar results were found. [See following Abstract.]

G. E. A.

408. Stimulus-Sensation Relation for Audition from Data on the Minimum Perceptible Changes of Intensity. H. Davies. *Phil. Mag.* 18. pp. 940-949, Nov., 1934. *Supplement*.—It is first pointed out that since the number of decibels change which is just perceptible varies greatly at different levels, the Weber-Fechner law does not hold for audition. The loudness on an arbitrary scale is plotted against the intensity to obtain the "loudness curve" or curve showing the relation of stimulus to sensation. It is also drawn, by a method which is indicated, by using the data for minimum perceptible change [see preceding Abstract], and the agreement is found to be satisfactory. From the same source are found the intensities which, applied to one and to both ears respectively, produce the same magnitude of sensation. The graph agrees with the course of the points determined by direct experiment by Fletcher and Munson. [See Abstract 5386 (1933).]

G. E. A.

409. Loudness Measurement. N. R. Campbell and G. C. Marris. *Phys. Soc., Proc.* 47. pp. 155-170; *Disc.*, 170-183, Jan. 1, 1934.—After briefly discussing the general theory of measurement and the use of terms, the authors re-state certain facts of audition before inquiring whether or not an entirely satisfactory scale of loudness is possible and proceed to determine if any one of those already proposed is distinguished by surer foundation in fact or greater freedom from arbitrary convention. Questions of convenience or practicable accuracy of scale are extraneous to the present inquiry. No new scale is proposed. If one scale is to be distinguished from another by facts, some other facts must be introduced which

are not so intimately involved in the meaning of loudness. There is an important difference in this respect between scales for tones of the same frequency and scales for all sounds. Proposed scales for a single frequency, and then the problem of sounds in general, are considered. If we could only rid ourselves of the feeling that loudness ought to be additive, the only remaining problem would be to measure the loudness of complex sounds on some scale, no matter what. J. E. B.

***410. Acoustic Radiation Pressure on Spheres.** L. V. King. *Roy. Soc., Proc.* 147A. pp. 212-240, Nov. 15, 1934.—In a lengthy mathematical paper the author calculates the acoustic radiation pressure upon spheres in various types of sound field. It is shown that the radiation pressure on a sphere in a progressive wave is always in the direction of wave propagation. The actual value of the pressure is extremely small and it is concluded that it could not be detected even in water unless the sound intensity exceeded 100 db. The pressure is much larger when the sphere is in a stationary wave field. The pressure does not depend upon local specifications of the field (*e.g.* the mean energy density) but depends upon the nature of the field as related to the mode of generation of the sound waves. Small spheres in a stationary plane radiation field execute S.H.M. of a different frequency, the equilibrium position being at the antinodes for relatively dense spheres and at the nodes for relatively light spheres. Striæ can be formed under these conditions and the time of formation is of the order of $T/4$ where T is the time of oscillation of the particles. The trajectories in a stationary field of particles which are so small that their motion is principally controlled by viscosity are calculated and their density of distribution deduced. The suspension of small particles against gravity in a vertical stationary sound field is also investigated. The calculation may be used in designing a torsion balance for the measurement of amplitudes in stationary supersonic radiation fields. J. E. R. C.

***411. Frequency Meter for Visual Tuning.** A. Pitt. *Journ. Sci. Instruments*, 11. pp. 377-379, Dec., 1934.—An apparatus is described which determines, by the flashing of a neon discharge lamp, the difference of frequency of the fundamental pitch of a given sound wave from that of a fixed standard of frequency by the operation of one manual control.

AUTHOR.

See also Abstract 517.

ELECTRICITY AND MAGNETISM.

CONDUCTION AND DISCHARGE IN GASES.

412. Theory of Temperature Ionisation of Gas. Part II. General Theory and Relation between Temperature and Pressure Ionisation. M. Sugita. *Phys. Maths. Soc., Japan, Proc.* 16. pp. 401–413, Nov., 1934. *In English*.—The ionisation of a gas at high temperature in which the free electrons obey the law of classical statistics, is discussed. An explanation of the relation between temperature and pressure ionisation is provided. [For Part I see Abstract 3740 (1934).] G. C. McV.

413. Quenching of Corona Discharge by Suspended Particles. M. Pauthenier and Marguerite Moreau-Hanot. *Comptes Rendus*, 199. pp. 1193–1194, Nov. 26, 1934.—In a previous paper [see Abstract 3862 (1934)] the theory of the influence of an atmosphere of suspended particles on the corona discharge from a wire surrounded by a cylinder, has been developed. The present work is an attempt to confirm the results experimentally. So long as the drop in corona current is less than 30 %, theory and experiment appear to be in good agreement. The theory developed explains the progressive quenching of the corona discharge as the concentration of dust in the surrounding atmosphere is increased; the space-charge opposing more and more the emission of new charges from the central electrode. J. E. R.

414. Electrode Atomisation in Contact Breakers. R. Holm. *Zeits. f. techn. Physik*, 15. 11. pp. 483–487, 1934.—Measurements of atomisation are rendered difficult by the fact that the change in weight of an electrode is the difference between the loss due to atomisation and the gain due to deposition on the electrode. In order to differentiate between these two effects electrodes of widely different shapes were employed and rod electrodes were finally adopted 3–4 mm. in diameter, with rounded ends. Special contacts were employed for investigation of the effects at “make” and at “break” and by the use of capacitative discharges for limiting the current duration reliable results were obtained. It was found that the atomisation in contact breakers, where an arc forms, is determined by a potential characteristic of the metal of which the electrodes are made. The quantity atomised is found to be proportional to the quantity q of electricity flowing through the arc. The proportionality factor was determined for a large number of metals and the value of q is calculable for any particular contact that may be used. For the case where the contact spark does not develop into an arc it is possible to calculate in advance the amount of atomisation. A. W.

415. Electrical Discharge in the Wilson Cloud-Chamber. H. Kroemer. *Arch. f. Elektrot.* 28. pp. 703–710, Nov. 10, 1934.—If air which is saturated with water vapour is allowed to expand suddenly, drops of moisture condense on ions which may be present and so render them visible. This artifice is employed to make visible some of the phenomena of dark discharge which precede the impulsive breakdown of a spark-gap. Air is expanded in the glass portion of a Wilson cloud-chamber, which contains the test electrodes, respectively spheres 12 mm. in dia. and needle points. The presence of the spheres causes eddies in the air flow and makes observation in homogeneous fields difficult, but

results with needle-point electrodes were good. A discharge is apparent of a structure similar to that of Lichtenberg figures and of poorer definition the lower the pressure. E. W.

416. Current-Voltage Characteristics and Counter Action of a Cylindrical Discharge at Atmospheric Pressure below Breakdown Field-Strength. A. Jodlbauer. *Zeits. f. Physik*, 92. 1-2. pp. 116-142, Nov. 2, 1934.—Current-voltage characteristics are determined by a bridge method for discharges at atmospheric pressure between a cylindrical copper electrode and an axial wire. In general a rise of current is observed from zero voltage up to the beginning of collisional ionisation by the electrons. Then for a range the Townsend relation is obeyed, after which there is a sharp rise of current. Finally the current-voltage curve becomes very flat again. Experiments are carried out with air and with hydrogen at atmospheric pressure and the effects of reversal of polarity and of illumination of the cylinder with ultra-violet light are investigated in detail. In the case of air without illumination it is found that the cylindrical gap acts at certain voltages as a counter responding to cosmic rays. L. A. W.

***417. Time-Lag of Sparkover in a Uniform Field.** A. Tilles. *Phys. Rev.* 46. pp. 1015-1022, Dec. 1, 1934.—An original instrument for measuring time-lag of sparkover has been developed. This is capable of measuring lags over a range from 10^{-5} sec. up to any longer values. This entire time-range is available for any individual measurement without readjustments and independently of the method or wave-shape of voltage application. Spark lags are found to fall into three distinct domains. First, long initiatory lags (10^{-1} to 10^{-3} sec. or less) of random distribution spent in awaiting a favourable fortuitous space and time arrangement of the somewhat insufficient supply of initiatory electrons. Second, intermediate formative lags (of the order 10^{-4} sec.) distributed about a definite peak value of the order of time required for a positive ion to cross the gap and assist in building up a space-charge gradient. Third, short formative lags (of the order 10^{-7} sec.) distributed about a definite peak value of the order of time required for an electron to cross the gap. A picture of the mechanism of sparkover in an initially uniform field is presented accounting for the existence of these three domains. The available experimental reports are correlated and shown to be consistent with each other and with the proposed explanation. AUTHOR.

418. Energy of Agitation of Positive Ions in Argon. F. L. Jones. *Phys. Soc., Proc.* 47. pp. 74-85, Jan. 1, 1935.—The energy of agitation of positive argon ions was investigated for a range of electric forces Z from 5 to 50 V/cm. and for a range of pressures p from 3 to 0.24 mm. by means of the Townsend method of measuring the lateral diffusion of a beam of ions moving in a uniform electric field. In pure specimens of gas the energy of agitation of the ions was the same as that of the atoms of the gas, and independent of the pressure, when the ratio Z/p was less than about 20. For higher values of Z/p the mean energy was increased by the field; the values obtained are compared with those calculated on the assumption that the ions behave as perfectly elastic spheres which attract the atoms of the gas with a force varying as the inverse fifth power of the distance. The motion of the ions was found to be very sensitive to the presence of impurities, and the general effect of the impurities at pressures greater than 0.4 mm. and when Z/p was less than 80 was to reduce the mean energy of agitation of the ions to the value possessed by

the atoms of the gas. This is probably due to the formation of ionic clusters. [See Abstract 1713 (1932).] AUTHOR.

419. Moving Striations in Neon. (Miss) B. van Manen. *Physica*, 1. pp. 967-978, Oct.-Nov., 1934. *In German*.—Measurements were made, in the positive column of a neon discharge with moving striations, of the difference in volts between the potential maximum and minimum of a layer, of the electron temperature at these points and of the velocity and number of the moving striations in the tube. The gas pressure was 3.2 mm. of Hg. It was found, in the case of a tube with tungsten kathode, that the difference in volts between the potential maximum and minimum of a layer decreased with increase of the discharge current. For a tube with an oxide-coated kathode the difference was found to depend on the number of the striations; variation of the discharge current gave rise to effects which made measurements very difficult. The velocity and number of the moving striations was found to vary in a discontinuous manner with variation of the discharge current and the jumps observed were found to occur at different values of the discharge current as the current was increased or decreased. A. W.

420. Starting Potential of the Glow Discharge in Neon-Argon Mixtures between Large Parallel Plates. F. M. Penning and C. C. J. Addink. *Physica*, 1. pp. 1007-1044, Oct.-Nov., 1934. *In English*.—The author has previously shown [see Abstract 1343 (1932)] that the sparking potential of a noble gas may be decreased considerably by a very small admixture of another gas when the excitation potential of the metastable states of the main gas exceeds the ionisation potential of the mixture. Measurements have now been extended to several Ne-A mixtures, pure A included, using large parallel iron plates; the purpose of this paper is to give a complete survey of the whole region of mixtures from pure A to pure Ne. The enlarged and improved apparatus is described in detail, and also the method of preparation of the Ne, and the method of measurement. Tables and curves of results are given and the accuracy claimed is a few per cent. The results are compared with those of other workers. A lengthy discussion of the ionisation and excitation by electrons and metastable atoms follows in which an attempt is made to connect the behaviour of the starting potential of the corona discharge with the elementary processes. R. L.

421. Electron Energies in the Negative Glow. K. G. Emeléus and D. Kennedy. *Phil. Mag.* 18. pp. 874-878, Nov., 1934. *Supplement*.—The average energy of electrons which enter the negative glow from the kathode dark space of a glow discharge in rarefied water vapour has been calculated by Linder [see Abstract 4347 (1931)]. Linder assumed the electric field in the kathode dark space to vary parabolically with distance from zero at the negative glow to a maximum at the kathode surface. The same average energy is now calculated assuming a law of variation of the electric field which differs considerably from parabolic form and for which there is rather more experimental support. It is found that Linder's result is insensitive to the form of the law of the electric field in the kathode dark space since both Linder's and the present calculation show that the electrons entering the kathode dark space retain only one-sixth of the energy expended in maintaining the kathode dark space. This result is probably roughly valid for any discharge and shows that there is a serious limit to the efficiency of a glow discharge when used for the purpose of carrying out chemical reactions in the negative glow. J. E. K.

***422. Purification of Mercury by Kathode Sputtering in Electric Arc Still.** R. K. Cowsik. *Indian Journ. Phys.* 9. pp. 21-34, Sept., 1934. —Details of purification of mercury. A. S. C. L.

423. Ionisation Potentials and Energies of Formation of Halogen Molecules. J. Savard. *Comptes Rendus*, 199. pp. 939-941, Nov. 5, 1934.—With the aid of a previous formula [see Abstract 1268 (1934)] the author has calculated the ionisation potentials of BrCl, ICl, and IBr to be 12·9, 11·9 and 11·6 volts respectively; these values are very similar to those deduced by Mulliken from a different standpoint. In like manner the ionisation potentials of F₂ and HF are found to be 17·8 and 17·7 volts respectively. H. H. Ho.

424. Excitation Potential of the Nitrogen Second Positive Bands. N. Thompson and S. E. Williams. *Roy. Soc., Proc.* 147A. pp. 583-593, Dec. 1, 1934.—An accurate method of determining the excitation potential of optical levels by electron impact is described. A value of $13\cdot16 \pm 0\cdot05$ volts was found for the energy of the C³Π level of the nitrogen molecule, which is in agreement with previous less accurate determinations. Indications were obtained of a possible fine structure of the excitation function near the excitation potential. It was observed that the first positive bands spread beyond the limits of the electron beam, while the second positive group do not, and possible explanations are suggested and discussed.

AUTHORS.

425. Formation of Negative Ions in Gases. Part I. NH₃, CO, NO, HCl and Cl₂. N. E. Bradbury. *J. Chem. Phys.* 2. pp. 827-834, Dec., 1934.—Previous results [see Abstract 763 (1934)] have been extended to all the common diatomic gases and NH₃. No negative ions are formed in NH₃ below an X/p of 7·5; beyond that point they are formed with increasing probability as the energy of the electrons increases. The phenomenon is interpreted as dissociation of the molecule with the formation of NH⁻ at an electronic energy of approximately 3 volts, the NH₃ molecule having itself no electron affinity. No negative ions could be formed in CO at the electronic energies available, and the molecule is presumed to have no electron affinity. Negative ions are formed by electron attachment in NO, the probability increasing with decrease in electronic energy. A linear variation in probability of attachment with pressure is also observed in NO which is due to a collision with a pair of NO molecules held together by weak attractive forces. Negative ions are formed in HCl with a probability which increases with increasing electronic energy suggesting that dissociation of the molecule occurs here as well. Similar results are obtained in Cl₂ where it has been known that the energy of the attachment process must be more than sufficient to dissociate the molecule. The experiments indicate several types of attachment processes which can occur in gases and the possibilities of energy dissipation in ion formation. In general the most favoured process is the carrying off of the energy by a third body involved in the process. [See following Abstract.]

AUTHOR.

426. Formation of Negative Ions in Gases. Part II. CO₂, N₂O, SO₂, H₂S and H₂O. N. E. Bradbury and H. E. Tatel. *J. Chem. Phys.* 2. pp. 835-839, Dec., 1934.—No negative ions were observed in CO₂. In N₂O, below $X/p = 2$, no negative ions were formed, and the N₂O molecule apparently has no electron affinity. For values of $X/p > 2$, the electrons possessed sufficient energy to dissociate the molecule and negative ions, probably O⁻, were formed in increasing numbers. SO₂ showed an electron affinity forming negative ions with electrons of very low velocity.

The probability of attachment decreased as X/p increased until an X/p of about 13 when an increase in probability of formation was noted. This is probably due to dissociation and formation of SO^- . No negative ions were observed in H_2S below an X/p of 6. For greater values of X/p negative ions were formed in increasing amounts presumably by a dissociation process with the formation of HS^- . A similar behaviour was observed in H_2O at an $X/p = 10$, with the formation of OH^- . Negative ion formation in H_2O was also observed at low X/p and varied with the pressure of the gas. This is explained as being due to negative ion formation from small molecular aggregates existing near the point of condensation of the water. [See preceding Abstract.] AUTHORS.

427. Reactions by the Collision of K^+ Ions with Gas Particles.

O. Schmidt. *Ann. d. Physik*, 21. 3. pp. 241-273, Nov., 1934.—The collision processes between gas molecules and slow K^+ ions depend largely on the symmetry of the distribution curve of the gas (as determined by the mass-spectrograph). For perfectly symmetrical distributions, as in the case of Hg vapour, the rare gases of higher atomic weights, methyl chloride, N_2 and CO_2 , pure scattering is observed for accelerating potentials up to 200 volts; the energy losses are very small and the collisions are elastic. For all other gases the collisions are inelastic and the energy losses are appreciable. The energy loss per collision is deduced for the two types of collision from the mass-spectrograph results. A theoretical investigation shows that the collision time, which is a function of the hardness and the inertia of the colliding gas molecule, determines whether the collision is elastic or inelastic.

H. J. H. S.

428. Electrical Absorption of Gases at Very Low Pressures.

W. v. Meyeren. *Zeits. f. Physik*, 91. 11-12. pp. 727-736, Oct. 23, 1934.—The electrical properties of He, A and N_2 were studied in the pressure range 5×10^{-4} to 10^{-7} mm. of mercury in a hot-cathode tube with an annular anode, and applying a longitudinal magnetic field. For He a small absorption was obtained only by using a magnetic field, while A was somewhat absorbed even without a field. In the cases of all three gases the degree of absorption depends on the voltage and the strength of the magnetic field. The adsorption process may be represented by a simple exponential function with a negative adsorption coefficient, providing the electrical conditions remain constant. The absorption was also found to be proportional to the initial gas pressure. [See Abstract 4386 (1933)].

G. E. B.

429. Active Chlorine. E. J. B. Willey and S. G. Foord. *Roy.*

Soc., Proc. 147A. pp. 309-332, Nov. 15, 1934.—Evidence for the existence of an active form of chlorine, produced by an electric discharge in the gas, was investigated. Activation is not accompanied by any appreciable volume change, and no special absorption spectrum could be detected. Reactions of activated chlorine with a number of organic and inorganic substances showed, in some cases, no abnormality; in others, notably the reaction with benzene, there was increased activity. The active form is not produced, or else is decomposed rapidly, in the absence of small traces of impurity. No increase of activity was produced by irradiation with ultra-violet light before, during or after the discharge. The stabilisation of the active form, and the possibility of the reactions being due to an active form or to a new compound of nitrogen, oxygen and chlorine, or the combined action of a compound of these gases and the active form are discussed. It is probable that the phenomena observed are due to a trace of atomic

chlorine whose behaviour is markedly dependent on the surface characteristics of the apparatus. N. M. B.

***430. Resistances for Geiger Counters, and Absolute Counting Rate.** R. Kühn. *Zeits. f. Instrumentenk.* 54. pp. 415-418, Nov., 1934.—It is shown that the characteristics of a Geiger counter depend on the nature, as well as on the ohmic value, of the resistance used with it. The best results were obtained with resistances of silicon, and of a certain solid organic material whose identity is not revealed. A method of determining what is the true counting rate of a counter is described. D. H. F.

See also Abstracts 27, 221, 298, 377.

CONDUCTION IN SOLIDS AND LIQUIDS.

431. Mechanism of Electrical Conductivity. R. W. Pohl. *Zeits. f. Metallkunde*, 26. pp. 217-219, Oct., 1934.—Electrical conductivity may take place by the transport of either charged ions or electrons. Whereas both types of conduction can be readily demonstrated in a gaseous medium, this becomes more difficult in solids. The formation and movement of colour centres within alkali-halide crystals has recently been reported, however, and the bearing which this has on the process of electrical conductivity is now discussed. R. W. P.

432. Mean Free Path of Electrons in Metals. A. Eucken and F. Förster. *Zeits. f. Metallkunde*, 26. pp. 232-235, Oct., 1934.—The mean free path of electrons in a metallic conductor is deduced from measurements of the specific resistance of a series of very fine wires ranging in diameter to about 1μ . Previous experiments using Bi [see Abstract 4297 (1934)] are referred to, which were in agreement with the classical theory rather than the Fermi-Sommerfeld theory. The present paper describes a method for the preparation of very fine wires of Ag, and of measuring diameters of less than 1μ by means of torsional oscillations. The resistance measurements lead to a value for the mean free path of electrons in Ag at 0°C. of $57.7 \times 10^{-7}\text{ cm.}$ ($\pm 1.5\%$), whereas the value indicated by the Fermi-Sommerfeld theory is 57.5×10^{-7} . At 14°K. , however, the value is about 25 % less than that given by this theory. R. W. P.

433. Interaction of Electrons in Metals. E. Wigner. *Phys. Rev.* 46. pp. 1002-1011, Dec. 1, 1934.—The energy of interaction between free electrons in an electron gas is considered. The interaction energy of electrons with parallel spin is known to be that of the space charges plus the exchange integrals, and these terms modify the shape of the wave functions but slightly. The interaction of the electrons with antiparallel spin, contains, in addition to the interaction of uniformly distributed space charges, another term. This term is due to the fact that the electrons repel each other and try to keep as far apart as possible. The total energy of the system will be decreased through the corresponding modification of the wave function. In the present paper it is attempted to calculate this "correlation energy" by an approximation method which is, essentially, a development of the energy by means of the Rayleigh-Schrödinger perturbation theory in a power series of e^2 . AUTHOR.

***434. D.C. Amplifier.** M. Meunier and J. Andriot. *J. de Physique et le Radium*, 5. pp. 538-540, Oct., 1934.—An amplifier is described in which two tetrodes are used in a bridge circuit, only one battery being used. The circuit is independent of battery fluctuation. The circuit is

easy to construct and to control, and its application to microphotometry is described.

D. H. F.

***435. Absolute Measurement of Electrical Resistance by a Rotating-Coil Method.** H. R. Nettleton and E. G. Balls. *Phys. Soc., Proc.* 47. pp. 54-67; *Disc.*, 68, Jan. 1, 1935.—A coil spins at a uniform angular velocity in the magnetic field produced by two fixed coils carrying a constant current, which also passes through the resistor to be standardised. The coils are so proportioned that the e.m.f. induced in the rotor is constant during an appreciable portion of each rotation, and by means of a suitable commutator and galvanometer, this constant e.m.f. is balanced against the p.d. across the resistor, whose resistance, R , is then obtained in terms of the angular velocity of the coil, ω , and the mean change of mutual inductance of fixed and moving coils per unit angle of rotation of the latter (M/θ) throughout that portion of each rotation for which balance is obtained. The laws governing the mutual inductance of the system are investigated, and designs for suitable coils and commutators are derived. It is also shown that the angle θ may be derived from the ratio of two mutual inductances. Preliminary experiments gave an accuracy of perhaps 1 part in 10,000.

L. H.

436. Effect of Temperature upon the Electrical Conductivity of Thin Layers of Copper Sulphide. H. Devaux and J. Cayrel. *Comptes Rendus*, 199. pp. 912-914, Nov. 5, 1934.—The sulphide layers used are about 100 to 200 Å thick and are supported upon porcelain. Starting from room-temperature, the electrical conductivity (as measured by the bridge method between gold electrodes pressed upon the sulphide) is observed to increase with rise of temperature to a maximum at 75 to 95° C. Further heating causes a rapid decrease of conductivity. Provided that the maximum is not passed, the increase of conductivity due to rise of temperature (factor 3 to 30) is maintained by the specimen when it is cooled down again. Renewed heating then has little further effect. Only after long ageing is the conductivity increase partially lost, when it may be regained once more by heating. The increase is supposed to be due to the expulsion of occluded gases, especially water vapour.

L. A. W.

437. Effect of Temperature and Visible and Infra-Red Radiations on the Resistance of Boron. R. Freymann and A. Stieber. *Comptes Rendus*, 199. pp. 1109-1110, Nov. 19, 1934.—These experiments comprise the results of Weintraub as regards the remarkably rapid variation of resistance in the neighbourhood of room-temperature—about 2 % per degree. A sample of B having a resistance of 100 megohms in the dark fell to 35 megohms under the light of a pointolite lamp. A spectral investigation showed that B is sensitive to 1.2μ in the infra-red and to 0.44μ in the violet. The maximum effect occurs at 0.837μ . It is not yet clear whether the effect is a thermal one only or whether it is true photoconductivity.

J. E.

438. Temperature Coefficient of Electrical Conductivity of Thin Metallic Layers. R. Deaglio. *Zeits. f. Physik*, 91. 9-10. pp. 657-659, Oct. 14, 1934. *N. Cimento*, 11. pp. 547-549, Aug.-Sept.-Oct., 1934.—The relation between the electrical conductivity of a thin metallic layer, σ , and its temperature coefficient $\alpha \left(= \frac{1}{\sigma} \frac{d\sigma}{dt} \right)$ is investigated experimentally. Metallic layers obtained by cathodic sputtering are used, the conductivity varying between 10^{-6} and 10^{-8} ohm $^{-1}$ cm. $^{-1}$. α is found to vary

from slightly less than zero to 4×10^{-2} . The results of W. Biltz (*Zeits. f. Anorg. Chem.* 133, 306, 1924) are thus generally confirmed. J. E. R. C.

439. Conductivity of Thin Metallic Layers. E. Perucca. *Zeits. f. Physik*, 91, 9-10. pp. 660-669, Oct. 14, 1934. *N. Cimento*, 11. pp. 531-541, Aug.-Sept.-Oct., 1934.—Previous experiments have led to the conclusion that the surfaces of metals have an abnormally low conductivity and that the low conductivity of thin metallic layers is a special case of this phenomenon. In the present paper the author discusses the evidence for two alternative theories for thin conductors and concludes that both Kramers' hypothesis of an amorphous metallic phase and Tisza's theory of the mean free path of conduction electrons cannot completely account for the experimental results. Evidence in favour of the author's own theory is presented and the phenomenon of irreversible changes of conductivity with temperature is connected with the structure changes suggested by Kramers.

J. E. R. C.

***440. Contact Rectifier.** I. Psychès. *Comptes Rendus*, 199. pp. 1198-1199, Nov. 26, 1934.—In opposition to the conclusions of Anastasiades [see Abstract 775 (1934)] experiments are reported showing that both normal and reverse rectifying effects of the Elkon rectifier are due to the contact Cu sulphide/Mg, no p.d. being detectable at the contact Pb/Cu sulphide. C. A. S.

441. Effective Permeability of Supraconductors. F. G. A. Tarr and J. O. Wilhelm. *Roy. Soc. Canada, Trans.* 28. Sect. 3. pp. 61-63, May, 1934.—Meissner and Ochsenfeld (*Naturwiss.* 21, p. 787, 1933) described some experiments showing that on lowering the temperature of a supraconductor in a constant magnetic field from above the transition point to below the supraconducting point, the distribution of the lines of force near the supraconductor became almost what would be expected if the permeability of the supraconductor had become zero. The present work was undertaken to confirm these experiments by an independent method. The results obtained verify the results of Meissner and Ochsenfeld quite well quantitatively. R. L.

442. Supraconductivity of Thin Films. E. F. Burton, J. O. Wilhelm and A. D. Misener. *Roy. Soc. Canada, Trans.* 28. Sect. 3. pp. 65-79, May, 1934.—It has been shown by various workers that thin films of supraconductors show an abnormally high sensitivity to current strength and the authors describe a systematic investigation of the supraconductivity of thin films. Their experiments show that films deposited by different methods under different conditions and on cores of different materials give similar results; that there is a limiting thickness, in the neighbourhood of 2×10^{-5} cm. for tin, for films which are supraconducting (above 1.9° K); sensitivity to current strength is a function of the thickness, particularly for films less than 10^{-4} cm. thick; and that plating thin films with an external metallic coating of a non-supraconducting metal destroys the supraconductivity of the film (above 1.9° K.). R. L.

443. Supraconductivity. A. J. Rutgers. *Physica*, 1. pp. 1055-1058, Oct.-Nov., 1934. *In English*.—A derivation is given of the equation $(dH/dT_0)^2 = 4\pi\rho c/T_0$, where dH/dT_0 is the slope of the magnetic transition curve, ρ the density of the metal and c the jump in the specific heat (*i.e.*, c supra- c normal) all at T_0 , the normal transition temperature. [See Abstract 2155 (1934)]. L. A. W.

444. Supraconductivity and Fermi-Dirac Statistics. J. A. Kok. *Physica*, 1. pp. 1103-1106, Oct.-Nov., 1934. *In English*.—Quantitative
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relationships are derived on the assumptions that the specific heat of a non-supraconductor shows a supplementary heat capacity due to the Fermi-gas of free electrons, that the curve of the magnetic threshold values is a parabola and that the specific heat of a supraconductor follows a T^3 law. The deductions are found to be in fair agreement with experimental data for Sn, Tl and In, assuming the number of free electrons per atom to be equal to the valency. L. A. W.

445. Surface Leakage and Conductivity. F. Quittner. *Phys. Zeits. d. Sowjetunion*, 6. 3. pp. 319–326, 1934. *In German*.—The paper deals with the criticism by A. D. Goldhammer [see Abstracts 3389 and 3390 (1934)] of the author's work on rock-salt crystals [see Abstract 591 (1931)]. The author shows that the provision of a guard-ring does not affect the values of back e.m.f. for rock-salt, and maintains that the results described in his previous paper are free from error. E. R.

446. Electrical Conductivity of Glass. Parts I and II. H. R. Kiehl. *Physics*, 5. pp. 363–373, Dec., 1934.—In Part I an effort is made to distinguish more clearly between two types of phenomena which may occur in some glasses: (1) a "reversible absorption" current due to the formation of a high counter e.m.f., and (2) an "irreversible absorption" current due to the formation of a highly resistant layer in the glass. Characteristic curves showing one type of the latter which may occur under certain conditions are given. Although many observers seem to have observed both phenomena previously, considerable confusion still seems to exist in distinguishing between them. Combinations of both phenomena may be one possible cause of some of the large discrepancies in current-time behaviours reported. A study of the relatively small, slowly decreasing residual e.m.f. observed upon discharging the sample shows a linear increase of this e.m.f. with increase in temperature for temperatures as high as 150°C . With the production of certain types of highly resistant layers in some glasses, increases of current with time are observed, similar to those reported qualitatively by several earlier investigators. In Part II the nature of these current increases has been studied quantitatively and found to follow, for the cases studied, the relationship, $\log(I_m - I_t) = \log a_1 - b_1 t$, where I_m is the maximum value of the current, I_t is the current at any time t after application of the field, and a_1 and b_1 are constants. The time T for the current to reach its maximum value seems related to the applied voltage by the equation $T = K_1/V - K_2$. The values of the constants K_1 and K_2 seem to decrease with increase in temperature. The time for the current to reach its maximum value decreases rapidly with increase in glass temperature. The possible importance of the phenomena observed in an explanation of the processes involved in the conductivity of glass is suggested, and the need for further investigation is emphasised. No theoretical explanation is given because of the apparent necessity for further investigations. AUTHOR.

See also Abstracts 29, 39, 78, 358, 359, 455, 463, 469, 492, 512.

DIELECTRICS AND CAPACITANCE.

447. Dipole Moment of Chloro-Methyl-Ether. M. A. G. Rau and B. N. Narayanaswamy. *Indian Acad. Sci., Proc.* 1A. pp. 217–223, Oct., 1934.—The moment of chloro-methyl-ether has been measured in CCl_4 and in C_6H_6 as solvents. The observed value of the moment agrees VOL. XXXVIII.—A.—1935.

best with the postulate that either the $-\text{CH}_2\text{Cl}$ group is freely rotating or that there is an equilibrium between the *cis* and *trans* states of the molecule.

AUTHORS.

448. Dielectric Constants of Amphoteric Electrolyte Solutions. Parts I and II. Existence of the Doublet Ion. O. Blüh and J. Kroczek. *Zeits. f. phys. Chem.* 27. *Abt.B.* 3-4. pp. 263-281, 1934.—The doublet ions occurring in solutions of amphoteric electrolytes may be regarded as electric dipoles of large moment, whose existence must, therefore, effect increase in the dielectric constant of the solvent. Investigations on aliphatic amphoteric electrolyte solutions confirmed this conclusion, but certain measurements on aromatic electrolytes were at variance therewith. Review of the theoretical and experimental material justifies suspicion of these discordant data. Measurements have now been made of the dielectric constants of various aromatic amphoteric electrolyte solutions (sulphanilic acid, methyl orange, the aminobenzoic acids and hippuric acid). Use was made of Drude's second method with undamped vibrations of about 1 m. wave-length in such a way that a purely empirical comparison with solutions of strong electrolytes of equal h.f. conductivity was possible. In almost all cases the values for the amphoteric solutions were higher than those for the solvent, the excess being specially marked with sulphanilic and *m*-aminobenzoic acids. Evidently, then, doublet ions are present also in solutions of aromatic ampholytes. T. H. P.

449. Dipole Moments and Raman Effect of Molecules with Groups Capable of Free Rotation. S. Mizushima, Y. Morino and K. Higasi. *Phys. Zeits.* 35. pp. 905-911, Nov. 15, 1934.—Dipole moment measurements are given for $1\cdot2-\text{C}_2\text{H}_4\text{Br}_2$ in hexane, CCl_4 , benzene and CS_2 ; $1\cdot2-\text{C}_2\text{H}_4\text{ClBr}$ in hexane, and benzene; $1\cdot2-\text{C}_2\text{H}_4\text{I}_2$ in hexane; and $p-\text{C}_6\text{H}_4(\text{CH}_2\text{Br})_2$ in CCl_4 , benzene, and CS_2 . Ascertained values are compared with existing data. Raman spectra have been obtained and the intensity changes in Raman lines are discussed. Certain similarities in behaviour between the intensities of the Raman lines and the dipole moments are dealt with. W. R. A.

450. Determination of Dipole Moments in Solution. F. Fairbrother. *Chem. Soc., J.* pp. 1846-1849, Nov., 1934.—Molecular polarisation for nitrobenzene in decane and *p*-xylene are given for a wide temperature range. P_2 for each temperature is plotted against $(\epsilon - 1)/(\epsilon + 2)$ and the curves converge to a common point corresponding with a moment $4\cdot25 \times 10^{-18}$ e.s.u. Calculating from $\mu = 0\cdot01273 \sqrt{P\mu\text{I}}$ gives $4\cdot24 \times 10^{-18}$ for μ , which is close to the value obtained for gaseous nitrobenzene and is 7-8 % higher than the accepted value for the dipole moment in benzene solution. This value agrees with Muller's formula according to which all dipole moments in benzene must be multiplied by 1·067 to give the gas values. Previous work on the influence of solvent on the dipole moment of the solute is discussed. W. R. A.

451. Dielectric Behaviour of Germanium Tetrachloride. J. G. Miller. *Am. Chem. Soc., J.* 56. pp. 2360-2362, Nov., 1934.—Dielectric constants, densities, and polarisations of GeCl_4 as a liquid, and in solution in CCl_4 , at 30° and in the range 0 to 55° , respectively, were measured over a range of concentrations. The polarisation in CCl_4 is independent of the concentration and has the same value as that of the pure liquid at the same temperature. Results indicate zero moment for the molecule. The electronic polarisation is 30·594 and the atomic polarisation 6·53 at 30° ,

as calculated from the molecular refractivity. An important vibration frequency is indicated corresponding to a wave-length of 101.4μ .

N. M. B.

452. Dielectric Constant of Solutions of Electrolytes in Benzene. G. S. Hooper and C. A. Kraus. *Am. Chem. Soc., J.* 56. pp. 2265-2268, Nov., 1934.—Results of measurements are recorded for benzene solutions of tetraisoamylammonium picrate, triisoamylammonium picrate, tetraisoamylammonium bromide and silver perchlorate, chiefly between 10^{-4} and $10^{-3} N$. The limiting molecular polarisation of these compounds is about ten times that of ordinary polar molecules, 2400 to 7800 cc. The molecular polarisation decreases rapidly with increasing concentration for salts with two electrically symmetrical ions and only slowly for salts with unsymmetrical ions. The relation between the dielectric and other properties of these solutions is discussed.

AUTHORS.

453. Dielectric Constants of Aqueous Electrolytes by H.F. Method. M. Röver. *Ann. d. Physik*, 21. 3. pp. 320-344, Nov., 1934.—Measurements were made of the dielectric constants of aqueous solutions of $MgSO_4$ and $CuSO_4$, in the region of the equivalent concentration $\gamma^* = 0.006 \div 0.2$, by Hellmann's method [see Abstract 2623 (1934)]. The results agree with the Debye-Falkenhagen theory within the range of its validity. In the region of higher concentration there appears to be agreement with the measurements carried out by Hellmann and Zahn if these are corrected with the values for the h.f. conductivity measured by Rieckhoff. Various results hitherto obtained are collected and these with the author's results give a course of behaviour of the dielectric constants of aqueous solutions of $CuSO_4$ and $MgSO_4$ which comprehends a great portion of these results.

J. J. S.

454. Electron Concentration and Electric Strength of Rock-Salt. Lydia Inge and A. Walther. *Arch. f. Elektrot.* 28. pp. 729-736, Nov. 10, 1934.—The electric strength of rock-salt under impulse voltages is investigated, using point-plane electrodes. Both the breakdown voltage and the delay at breakdown are shown to be unaffected when the electron concentration is increased by the application of X-rays and by exposure to light. It is therefore concluded that breakdown is not due to ionisation by impact. In non-homogeneous fields the delay at breakdown is considerably greater when the point electrode is at negative potential. In other materials, e.g., glass and mica, further evidence against breakdown due to ionisation by impact is afforded by the fact that the electric strength is not dependent on the thickness and that no ionisation currents are observed before breakdown.

E. R.

455. Movement of the Ionic Lattice of Insulators at Extreme Field Strengths. A. Güntherschulze and H. Betz. *Zeits. f. Physik*, 92. 5-6. pp. 367-374, Nov. 26, 1934.—A continuation of recent work on this subject [see Abstract 5208 (1934)], particular attention being given to the ionic and electronic currents produced at various electrical field strengths in the oxide film formed on Al. Some provisional results are also given for Ta_2O_5 , and a delayed phenomenon which is observed in aged films is described. Explanations are suggested, and it is shown that the formulæ obtained for the ionic current indicate that fusion of Al_2O_3 should occur at a temperature within about 12 % of the accepted value.

R. W. P.

See also Abstracts 96, 134, 323.

ELECTROCHEMISTRY.

456. Life Tests of Commercial Standard Cells. T. T. Smith. *Rev. Sci. Instruments*, 5. pp. 425-427, Dec., 1934.—Measurements of the e.m.f. of standard cells made over periods of from 7 to 20 yr. show that the e.m.f. of the cells decreases at a rate which varies from cell to cell and which changes with the age of the cell. It seems further that a single cell may not be trusted unless it has been checked shortly before being used. These conclusions follow as the result of measurements where no attempt was made to keep the cells at a constant temperature.

AUTHOR.

457. Platinum Black. G. v. Hevesy and T. Somiya. *Zeits. f. phys. Chem.* 171. *Abt. A.* 1-2. pp. 41-48, 1934.—Platinum black, prepared by the method of Lummer and Kurlbaum, by the electrolysis of platinum chloride solution containing lead acetate, was shown to contain considerable amounts of lead (1.5 %). The lead present in the platinum black was shown to vary with the lead content of the solution. Electrolysis of a solution containing 0.1 % lead acetate yielded a platinum black which contained 7 % of lead. The least polarisable platinum black was that prepared according to the method of Lummer and Kurlbaum. Platinum black was prepared from platinum chloride containing other metals than lead.

F. J. B.

458. Influence of Pressure on the Overvoltage of the Electrolysis of Water. H. M. Cassel and E. Krumbein. *Zeits. f. phys. Chem.* 171. *Abt. A.* 1-2. pp. 70-82, 1934.—The influence of pressure on the overvoltage of hydrogen has been examined in $N-H_2SO_4$ and $N-KNO_3$ at Pt, Ni and Ag electrodes. The influence of pressure on the overvoltages of O_2 from $N-H_2SO_4$ at Pt and PbO_2 and from $N-Cd(NO_3)_2$ at chrom-nickel steel consists, as with H_2 , in a depression of the overvoltage, this being less with PbO_2 than with Pt. Such depression of the overvoltage is in accord with theoretical expectation, but is considerably greater at the kathode than at the anode. No explanation is yet available for this behaviour.

T. H. P.

459. Electrochemical Chlorination of Benzene. W. Jeune-homme. *Comptes Rendus*, 199. pp. 1027-1029, Nov. 12, 1934.—When a solution of benzene in methyl alcohol containing HCl is electrolysed, e.g. 47 % (vol.) C_6H_6 , and 5.7 $N-HCl$, with c.d. 1 ampere/dm.², Pt anode and C kathode, two reactions occur simultaneously; (1) homogeneous, produced by molecules of chlorine in the solution, and (2) surface, probably produced by Cl atoms at the surface of the anode; the fraction of the chlorine reacting according to (2) increases with time. The chief product is C_6H_5Cl , a yield of 85 % having been attained: $C_6H_4Cl_2$, $C_6H_6Cl_6$ and chlorophenols were also detected.

C. A. S.

460. Kathodic Behaviour of Organic Copper Salts. G. Kravtsoff. *Comptes Rendus*, 199. pp. 1029-1031, Nov. 12, 1934.—Solutions, containing 15 g./l. Cu, of cupric formate and acetate were electrolysed with c.d.s. 0.01, 0.05 and 0.5 amp./dcm.², for periods of 0.25-24 hrs. As the period of electrolysis increases the production of Cu_2O , and the pH decrease. This is due to reduction of the cupric salt being predominant at first, but the cuprous salt thus formed hydrolyses with deposition of Cu_2O on the kathode and separation of acid, which as it increases in amount favours discharge of the Cu^{++} ion. The ratio of weight of deposit to weight in a coulombmeter decreases as c.d. increases. Formation of Cu_2O is a purely cathodic phenomenon. [See Abstract 4241 (1933) and following Abstract.]

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C. A. S.

461. Kathodic Behaviour of Organic Salts of Copper. G. Kravtsoff. *Comptes Rendus*, 199. pp. 1105-1107, Nov. 19, 1934.—The proportion of Cu_2O deposited increases with rise in temperature save in the case of the formate when there is a slight decrease and the deposit becomes striated. Hydrolysis alone would increase the amount and the behaviour of the formate must be due to the special reducing properties of formic acid. In general addition of another salt with the same anion decreases the amount of Cu_2O , but here again the formate is anomalous, the amount increasing on such addition with low c.d. (e.g. 25 mA./dm.²), and only decreasing with a higher c.d. (e.g. 100 mA.). The proportion of Cu_2O increases as the dissociation constant of the acid is smaller, e.g. with propionate the amount is greater than with acetate. The Cu_2O deposited from propionate is, that from formate is not, photoelectric. With the above-noted exceptions the behaviour of these salts resembles that of CuSO_4 . [See preceding Abstract.] C. A. S.

462. Electrolytic Separation of Cu-Ni-Fe Alloys. H. Paweck, J. Bauer and J. Dienbauer. *Zeits. f. Elektrochem.* 40. pp. 857-862, Dec., 1934.—The experiments now described were undertaken to establish whether and under what conditions the cathodic separation of an alloy of Cu, Ni and Fe was possible without the use of alkali cyanides. It was found that the separation takes place of such ternary alloys from solutions of the simple metallic sulphates containing sodium citrate. By variation of the electrolyte components and current density, alloys of any required composition may be obtained and the conditions are worked out for the formation of a Monel metal. The influence of the sodium citrate has been studied by current density-potential measurements. H. H. Ho.

463. Electrolytes in Mixed Solvents. Part VI. Conductivities of Salts in Water-Ethyl Alcohol Solutions. L. C. Connell, R. T. Hamilton and J. A. V. Butler. *Roy. Soc., Proc.* 147A. pp. 418-433, Dec. 1, 1934.—The electrical conductivities of LiCl , KI and ZnCl_2 have been determined in a series of water-ethyl alcohol solutions. The equivalent conductivities at infinite dilution of the first two salts, which are strong electrolytes in both pure solvents, have been determined. The change of Λ_0 is approximately proportional to the fluidity of the solvent until about 20 mol. % of alcohol are present. The solvation of the ions by alcohol molecules begins here and gives rise in greater proportions of alcohol to a steadily increasing divergence between the two. The Kohlrausch equation $\Lambda = \Lambda_0 - \kappa\sqrt{c}$ is obeyed in all the solvents, and the values of κ show on the whole a better agreement with Onsager's equation in the mixed than in the pure solvents. ZnCl_2 is apparently completely dissociated in water even at high concentrations, while in ethyl alcohol its behaviour is not far different from that of a weak uni-univalent electrolyte having a dissociation constant, $K_0 = 4 \times 10^{-8}$. In the mixed solvents at low concentrations ($c = 4 \times 10^{-4}$) the degree of dissociation remains unity until about 40 mol. % alcohol are present and then falls rapidly to comparatively small values, but at greater concentrations, the alcohol begins to reduce the degree of dissociation when present in smaller proportions. An estimate of the extent of complex ion formation in the alcoholic solutions is made. [For Part V see Abstract 4242 (1933).] AUTHORS.

464. Ionic Mobilities in Dielectric Liquids. I. Adamczewski. *Acad. Polonaise Sci. et Lettres, Bull.* 5-7A. pp. 217-230, May-July, 1934. *In German*.—The Langevin method of measuring ionic mobilities in dielectric liquids was employed as it was found to be the most exact method

available, and it was found that X-rays gave a much better ionic source than radium preparations. The object of the work was to investigate by a direct method the relation between ionic mobility and viscosity for the same chemical group in a series of compounds and to compare this with the viscosity coefficients of these liquids measured directly. The substances used are pentane, hexane, heptane and octane. A third ion was found in hexane, and three ionic mobilities were determined in pentane, heptane and octane. Graphs are given of the results. An empirical relation between ionic mobilities and viscosity coefficients was found for these substances.

R. L.

465. Potential Series of Acids and Bases. E. Wiberg. *Zeits. f. phys. Chem.* 171. *Abt. A.* 1-2. pp. 1-24, 1934.—The measure of acidity and basicity, that is, the tendency to take up or surrender a proton (positive charge) is shown to be the easily measured "acidity potential." The acidity potential is perfectly analogous with the reduction potential in a reduction-oxidation system. On the basis of these measurements, a potential series of acids and bases is constructed, which is shown to possess all the advantages of the oxidation-reduction potential series. F. J. B.

466. Breakdown Potential of Oxide Layers on Al Electrodes. W. C. van Geel. *Physica*, 1. pp. 989-995, Oct.-Nov., 1934. *In French*.—Plates of Al covered with Al_2O_3 layers of known thickness were used as electrodes in electrolytic cells under carefully controlled conditions. The breakdown potential of the oxide layer as determined by the appearance of sparks was found to depend upon the concentration and temperature of the electrolyte and the thickness of the oxide layer. The experimental results suggest that the current traversing the system is originated by cold emission of electrons from the negative electrode. J. E. R. C.

467. Overvoltage and Kathodic Lowering of the Mechanical Strength of Steel. D. Alexejew and P. Perminow. *Zeits. f. Elektrochem.* 40. pp. 823-826, Dec., 1934.—Measurements are made upon the effect of "poisoning" by H_2S and As_2O_3 on the overvoltages at Fe and Pt kathodes in $N\cdot\text{H}_2\text{SO}_4$, working with flowing electrolytes and in complete absence of oxygen. A lowering is observed for H_2S and an increase for As_2O_3 . Both of these substances are known, however, to produce a cathodic decrease of mechanical strength in steel [see Abstract 1314 (1934)]. Thus there is no parallelism between this effect and the magnitude of the overvoltage. [See following Abstract]. L. A. W.

468. Overvoltage of Kathodic Hydrogen and the Kathodic Lowering of the Mechanical Strength of Different Sorts of Steel. T. Krassó. *Zeits. f. Elektrochem.* 40. pp. 826-829, Dec., 1934.—It is found that certain kinds of steel (containing Ni and Cr) show cathodic decrease of mechanical strength even in absence of added "poisons" [see Abstract 1314 (1934)]. For such steels the overvoltage of hydrogen is higher than for steels which do not show the effect in pure electrolytes. Additions of Hg and As which induce cathodic lowering of mechanical strength, produce an increase of overvoltage. The effect upon mechanical strength is considered to be dependent upon the overvoltage exceeding a certain minimum. The recent results of Alexejew and Perminow upon additions of H_2S [see preceding Abstract] require further investigation. L. A. W.

469. Potentiometric and Conductometric Studies. Part II. J. Pleper. *Zeits. f. Elektrochem.* 40. pp. 844-857, Dec., 1934.—This paper continues Part I [see Abstract 5224 (1934)] and includes a very full
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description of the following : (1) discussion of graphical methods for end-point determination ; (2) mathematical computation of the end-point ; (3) titration of NaOH containing Na_2CO_3 with HCl ; (4) titration of HCl with NaOH containing carbonate ; (5) titration of Na_2CO_3 with HCl ; (6) titration of mixtures of NaOH and Na_2CO_3 with HCl ; (7) the apparatus of Jander and Schorstein ; (8) KCl titrations ; (9) KI titrations ; (10) determination of K with the triodometer. The paper should be consulted in its entirety. H. H. Ho.

470. Theory of the Glass Electrode. Part III. M. Dole. J. Chem. Phys. 2. pp. 862-866, Dec., 1934.—The application of Gurney's quantum and statistical mechanical theory of electrochemistry [see Abstract 3981 (1932)] to the glass electrode results in an equation for the alkaline solution behaviour identical with one previously obtained by the author except that the constants of the equation have a more reasonable significance. A qualitative explanation of the inability of negative ions to affect the glass electrode potentials is also given. [For Part II see Abstract 5348 (1932).] AUTHOR.

471. Anodic Passivation of Gold in Chloride Solutions. G. Armstrong and J. A. V. Butler. Faraday Soc., Trans. 30. pp. 1173-1177, Dec., 1934.—Measurements have been made of the times of passivation of gold electrodes in unstirred chloride solutions. The times are approximately proportional to the chloride ion concentration and are not appreciably affected by replacing HCl by KCl. For times over about 10 sec. the relation $it = i_0t + a$ holds (i = current, t = time, i_0 and a constants). In this relation a is regarded as the amount of electrolysis required to produce a diffusion layer, through which the diffusion of chloride ions to the electrode then takes place at the constant rate i_0 . A similar interpretation is given of Shutt and Walton's observation of a relation of the same kind under conditions of violent stirring [see Abstract 4697 (1934)]. The thickness of the diffusion layer is calculated in the two cases. [See Abstract 346 (1934)]. AUTHORS.

See also Abstracts 28, 29, 31, 42, 78, 135, 262, 263.

ELECTRONS, POSITRONS AND PROTONS, INCLUDING APPLICATIONS.

472. Annihilation of Positrons. J. Brunings. Physica, 1. pp. 996-1002, Oct.-Nov., 1934. In German.—The mutual annihilation of a positron and the K electron of an atom is discussed. The energy liberated by the process is assumed to be imparted to the other K electron which is then ejected from the atom with kinetic energy approximately equal to $2mc^2$. The effective cross-section for this process is calculated as a function of the energy of the positron, and is found to be greatest when the energy of the positron is equal to the K energy. The absolute probability for the process in lead is estimated as 10^{-6} . J. E. R. C.

473. Absorption Factor for Electron Diffraction. W. E. Laschekarew and A. S. Tschaban. Phys. Zeits. d. Sowjetunion, 6. 3. pp. 205-210, 1934. In German.—The relation between the relative intensities of the Debye lines and the inclination of the surface of an oxidised Mg specimen which is diffracting fast electrons is examined. It is shown that the absorption factor is the same as that found for X-rays. H. J. H. S.

474. Influence of Temperature on Diffraction of Slow Electrons by Single Crystals of Graphite. W. E. Laschkarew and G. A. Kusmin. *Phys. Zeits. d. Sowjetunion*, 6. 3. pp. 211-223, 1934. *In German*.—Variation with temperature of the intensity of the diffraction pattern obtained with the 0001 plane of a graphite crystal is examined and it is found that the Debye formula for X-ray diffraction is obeyed if a term is introduced for the refraction of the electron waves. The Debye temperature coefficient is the same in each case. From the experimental results it is deduced that the inner potential of graphite is constant at 18-20 volts. A strong reflection at 8 volts is shown to be a selective effect at the surface layer of the crystal. H. J. H. S.

475. Production of Electrons and Positrons by a Collision of Two Particles. L. Landau and E. Lifschitz. *Phys. Zeits. d. Sowjetunion*, 6. 3. pp. 244-257, 1934. *In English*.—The production of an electron and positron by a collision of two particles, moving with a velocity near to the velocity of light, is investigated. The cross-section of this effect is obtained; it increases with the cube of the logarithm of the energy of the colliding nuclei. AUTHORS.

476. Visual Observation of Diffraction of Slow Electrons by Crystals. W. Ehrenberg. *Phil. Mag.* 18. pp. 878-901, Nov., 1934. *Supplement*.—A beam of electrons is made to impinge on a crystal which can be rotated so that its faces may present any desired angle with respect to the beam. The diffracted electrons are accelerated in a radial field having the crystal at its centre so that they have sufficient velocities to excite fluorescence in a calcium tungstate screen placed in their paths. The electron diffraction patterns may thus be visually observed. A series of observations are made of the diffraction of 100-700 volt electrons by a copper crystal. The results are compared with those obtained by Farnsworth [see Abstract 3805 (1933)]. J. E. K.

477. Interpretation of Electron-Diffraction Photographs of Gas Molecules, with Results for Benzene and Carbon Tetrachloride. L. Pauling and L. O. Brockway. *J. Chem. Phys.* 2. pp. 867-880, Dec., 1934.—The reliability and accuracy of the visual method of interpreting electron-diffraction photographs, consisting in the correlation of values of $(4\pi \sin \vartheta/2)/\lambda$ obtained by visual measurement of rings of apparent maximum and minimum intensity with χ values from a simplified theoretical curve, have been tested in the following ways: (a) The measurement and interpretation of "artificial electron-diffraction photographs" of Br_2 ; (b) the comparison of electron-diffraction and band-spectral values of interatomic distances for Br_2 , Cl_2 and ICl ; (c) the study of microphotometer records for benzene, and comparison of results with those of the visual method; (d) the study of microphotometer records for CCl_4 , and comparison with the visual method. It is concluded that the visual method when carefully applied leads to values of interatomic distances accurate to about 1% (probable error), or to $\frac{1}{2}\%$ in favourable cases. The regular plane hexagon model of the benzene molecule is verified, the C-C distance in the ring being determined as $1.390 \pm 0.005 \text{ \AA}$. The C-Cl distance in the CCl_4 molecule is determined as $1.760 \pm 0.005 \text{ \AA}$. A brief discussion of the methods and results of other investigators is given. AUTHORS.

478. Elastic Electron Scattering in Potassium. J. H. McMillen. *Phys. Res.* 46. pp. 983-988, Dec. 1, 1934.—A method was developed for the measurement of slow electron scattering in vapours. Angular distribution

curves from 25° to 160° were obtained for 5, 10, 15, 25, 50, 75, 100 and 150 volt electrons elastically scattered by potassium atoms. All curves contained a large peak near 100° . The scattering curves fell off rapidly for angles up to about 60° and rose rapidly for angles greater than about 130° . The position of the peak was found to shift to larger and then smaller angles as the energy of the colliding electrons was decreased. Henneberg's calculations which employ the Thomas-Fermi atomic field were found to give scattering curves whose general shapes agree quite well with the experimental curves. Best agreement occurred for the 5 and 50 volt electrons. When the potassium and argon experimental curves were compared it was found that the curves were quite similar for electron energies of 50 volts or more. For slower electrons the curves became more dissimilar. AUTHOR.

479. Oxide Films on Liquid Metals Studied by Means of Electron-Diffraction. R. O. Jenkins. *Phys. Soc., Proc.*, 47. pp. 109-122, *Disc.*, 123-124, Jan. 1, 1935.—Electron-diffraction patterns obtained by reflection from molten lead, zinc, bismuth and tin have shown that the surfaces of these metals are covered with thin oxide films. From these patterns it has been deduced that the films consist of small electron-optically flat oxide crystals resting on their [001] faces. The inner potentials and crystal structures of these oxides have been found, and they have thus been identified as definite chemical compounds. It has also been found possible to remove these films from the molten metal by means of nickel gauze and to obtain electron-diffraction patterns by transmission. The transmission patterns indicate that although the removed films are of the same chemical composition as those on the molten metal, their removal has disturbed the orientation and given the crystals an approximately Maxwellian distribution or orientations about their original direction. AUTHOR.

480. Electron-Optical Observations of the Transformations of Iron at Temperatures between 500 and 1000°C . E. Brüche and W. Knecht. *Zeits. f. techn. Physik*, 15. 11. pp. 461-463; *Disc.*, 463, 1934.—The crystalline structure of Ni has already been examined with the electron microscope [see Abstract 825 (1934)] which is now applied to a study of the structural changes occurring in Fe at high temperatures. A thin layer of Ba is distilled on to the surface of the specimen; this becomes activated and emits electrons which are focussed by electron-optical means; the resulting image is similar to that obtained in an ordinary microscope by etching the surface of the specimen. The advantage of the electron-optical method is that it renders possible visual observations of transformations occurring on the surface of a specimen. A series of photographs illustrate the growth of iron crystals by annealing and the changes occurring in an Fe specimen over the range 615 to 1050°C . H. J. H. S.

481. Conditions and Limits of Correct Representation by Electron Projection. H. Seemann. *Zeits. f. Physik*, 92. 3-4. pp. 253-273, Nov. 12, 1934.—It is shown that correct representations cannot be obtained with incandescent wires in an electric field, since it is found that on such sources irregular field lenses are developed and these, under certain conditions, may produce effects greater than the main projection lenses, so that with any projection arrangement they produce unavoidable distortion. Further, it is shown that correct reproduction of the individual features of a body can be effected and half tones obtained only when the surface element of the active body is diffuse, but does not emit according to Lambert's law. These conditions are not even approximately fulfilled

in the case of bodies spontaneously emitting electrons and under the influence of an electric field. Reproduction is limited by the unavoidable curvature of the initial electron paths, which plays a similar part to that of wave-length in the optical reproduction of very small bodies. Comparison is made between the optical microscope pictures of tungsten wires and those obtained by use of an electron pinhole camera. The paths of the electrons from a rough, incandescent wire in a cylindrical electric field are also calculated. [See also Abstract 1242 (1933)]. A. W.

***482. Electron-Optical Immersion Lens.** E. Hess. *Zeits. f. Physik*, 92. 3-4. pp. 274-282, Nov. 12, 1934.—The path of the rays through an immersion lens (lens interposed between two regions with different refractive indices) is discussed by means of a series of diagrams. An investigation is then made of the properties of an electric immersion lens formed by pinholes in two parallel discs. The principal planes of this arrangement, in agreement with the optical analogue, are found to be displaced towards the side of low potential, which in the optical arrangement corresponds to the side with low index of refraction. A. W.

***483. Immersion Objective for Electron Optics.** H. Johansson. *Ann. d. Physik*, 21. 3. pp. 274-284, Nov., 1934.—Previous work [see Abstract 297 (1934)] is continued. A 4-electrode system for an electron-optical objective is described which is an improvement on the three-electrode objective. Two grating diaphragms are placed between the cathode and anode. With a fixed cathode-screen distance and anode potential, the variation in diameter of the sharply-focussed image and the magnification is examined with variation in the grating potentials and the distance between the cathode and the first grating. The results are given in graphical form. A minimum focal length of 1 mm. is obtained.

H. J. H. S.

***484. Kathode-Ray Oscillograph Acceleration-Grid.** H. Graupner. *Arch. f. Elektrot.* 28. pp. 727-728, Nov. 10, 1934.—The electrical field of the grid which is used in sensitive kathode-ray oscillographs to accelerate the electrons on to the screen, is not uniform. The consequent distortion of the ray is estimated and its effect upon the definition of the oscillogram is discussed. E. W.

See also Abstracts 13, 14, 22, 24, 211, 331, 425, 426, 427, 432, 493.

ELECTROSTATICS.

485. Electrostatic Problems Involving an Elliptical Integral. H. Tallqvist. *Soc. Scien. Fennica, Comm. Phys.-Math.* 7. 8. [11 pp.], 1934. *In German.*—A mathematical discussion is given of several problems in electrostatics: (1) The case of a sphere with a concentric surrounding charged circular line in its equatorial plane. In this case the distribution of electricity on the sphere produced by influence can be completely calculated. (2) When the circular line is above the equatorial plane of the sphere. (3) The charged circular line is inside the sphere and in the equatorial plane. (4) The charged circular line is within the sphere and above the equatorial plane. (5) The problem of an infinite plane with a charged circular line parallel to it. J. J. S.

***486. Electrostatic Machines.** P. Jolivet. *R.G.E.* 36. pp. 698-701, Nov. 17, 1934.—Three new models of electrostatic machines are described. The energy is supplied by the rotation of a disc of insulating material and the machine is excited by a residual charge which by a commutator charges

a condenser and then builds up a high voltage. In the third model, the principle of Faraday's pail is also introduced. Voltages of 90,000 to 116,000 are obtained for a power of 6 or 7 W.

H. M. B.

See also Abstracts 112, 413.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

See Abstracts 441, 443.

MAGNETISM AND ELECTROMAGNETISM.

487. Proposed Reformulation of Electromagnetic Equations and Revision of Units. L. Page and N. I. Adams, Jr. *Frank. Inst., J.* 218. pp. 517-531, Nov., 1934.—Any attempt to reach an ideal solution to the formulation of electromagnetic equations and the selection of units will be abortive if it ignores present usage and the practical requirements of physicist and engineer. No single set of equations and single system of units would be acceptable to both parties. The only practicable course is to recognise the need for two sets of equations and two systems of units, one for the physicist the other for the engineer, and to choose the systems of units so that the transformations from one to the other may be as simple as possible. Both sets of equations should be in such form as to exhibit the symmetry existing between electrical and magnetic quantities. This halves the number of coefficients and transformation factors involved. The authors present the most general symmetrical form in which the electromagnetic equations can be put. The Heaviside-Lorentz equations are the most attractive to theoretical physicists, but the Gaussian equations are recommended because the use of Maxwell's electrostatic and electromagnetic units is so general. The engineer's prime requisites are that his equations should utilise the eight international practical units and be based on the metre, kg. and sec. Very few factors are required to transform an equation from Gaussian c.g.s. units to practical m.k.s. units or *vice versa*. The two systems of units are tabulated and compared. Numerical examples of calculations in practical m.k.s. units are given. Equations of circuit theory remain as at present in either Gaussian c.g.s. or practical m.k.s. units; and equations for induced e.m.f. in terms of rate of flux change remain as at present in practical m.k.s. units.

R. E. N.

488. Mechanical Damping of Ferromagnetic Materials by Magnetisation. M. Kersten. *Zeits. f. techn. Physik*, 15. 11. pp. 463-467, 1934.—It has been shown that the mechanical damping of a ferromagnetic body is greatly affected if the body is magnetised to a degree which is below the saturation value [see Abstract 3235 (1933)]. It is shown that the damping is due to eddy currents which arise in the oscillating body through variations in magnetisation and which are coupled with the mechanical oscillations. The calculated damping factor is found to agree with that found experimentally.

H. J. H. S.

489. Magnetochemical Properties of Samarium. P. W. Selwood. *Am. Chem. Soc., J.* 56. pp. 2392-2394, Nov., 1934.—Magnetic susceptibility measurements have been made on Sm_2O_3 , $\text{Sm}_2(\text{SO}_4)_3 \cdot 8\text{H}_2\text{O}$, SmBr_3 and SmBr_2 . Divalent Sm is shown to have a definite existence. The susceptibilities and electronic configurations of divalent Sm and trivalent Eu are shown to be identical.

W. R. A.

490. Change of Magnetic Susceptibility of an Electron Gas with Temperature. K. F. Niessen. *Physica*, 1. pp. 979-988, Oct.-Nov., 1934.—Mathematical—a continuation of earlier work [see Abstract 4346 (1934)]. Assuming free electrons, the increase of the magnetic susceptibility of an electron gas with temperature is shown to follow the relation $X = n\mu_B^2 (1 + \pi^2 k^2 T^2 / 12 W_0^2) / W_0$, where n = no. of electrons per cc., $\mu_B = eh/4mc$ (Bohr magneton) and $W_0 = (3n/8\pi)^{2/3} h^2 / 2m$ (Fermi boundary energy when $T = 0$). W. R. A.

491. Susceptibility Measurements on Aluminium Mixed Crystals. H. Auer. *Zeits. f. Physik*, 92. 5-6. pp. 283-290, Nov. 26, 1934.—Magnetic measurements are carried out by the Gouy balance method upon "pure" Al and its alloys. In the case of mixed crystals systematic deviations from additivity are observed. These are explained by supposing that the susceptibility of the main metal, as well as of the added metal, is changed in the direction of diamagnetism. The "free" ferromagnetic iron content, as estimated from the dependence of susceptibility upon field, is found to be much lower than the total iron content determined by spectrum analysis of the specimens. L. A. W.

492. Magnetic, Electric and Spectrographic Investigations upon Gold-Silver Alloys. H. Auer, E. Riedl and H. J. Seemann. *Zeits. f. Physik*, 92. 5-6. pp. 291-302, Nov. 26, 1934.—Magnetic susceptibility and electrical resistance are measured for two series of Au-Ag alloys after different preliminary treatment, viz., glowing in vacuum and in nitrogen and melting in vacuum. The mean differences in the measured properties are found to be less than 1 %. This result is at variance with the work of Shimizu, who finds very large changes of susceptibility following similar treatment. The specimens are also subjected to spectroscopic analysis, which indicates that by far the greater part of the iron present in them is situated at the surface, the internal Fe content being practically the same for all the alloys and equal to only 10^{-4} %. L. A. W.

493. Discontinuity in Electromagnetism. W. H. Watson. *Roy. Soc. Canada, Trans.* 28. Sect. 3. pp. 1-28, May, 1934.—The author gives a mathematical study of the discontinuity implied in electromagnetic theory by the existence of discrete electric charge elements (electron, etc.). In the theory developed, the electronic charge e plays an analogous rôle to the quantum of action h in wave mechanics, and an uncertainty principle for electromagnetic fields is derived. The possibility of an experimental test of the theory is touched upon. W. S. S.

494. Tubes of Electromagnetic Force. R. N. Sen. *Calcutta Math. Soc., Bull.* 25. pp. 191-196, Dec., 1933.—Not suitable for abstraction. [See Abstract 1352 (1922).]

495. Computation of Integrals in Mutual-Inductance Calculations. N. F. Astbury. *Phys. Soc., Proc.* 47. pp. 86-91, Jan. 1, 1935.—A method, based on the reduction of classical formulæ, whereby the numerical computation of complete elliptic integrals of the third kind can be considerably simplified in certain cases is suggested. A particular case considered in detail is that which arises in the calculation of the mutual inductance of a helix and a coaxial circle. A considerably simplified formula, well adapted for numerical working, is deduced, together with an extremely simple result for the case when the helix and circle have the same radius.

AUTHOR.

***496. Apparatus for Permeability-Tension Tests.** G. A. Kelsall and H. J. Williams. *Rev. Sci. Instruments*, 5. pp. 437-440, Dec., 1934.—A device is described for making permeability-tension tests on a ferromagnetic material in the form of a tape bent into a triangle. This form has the advantage over the usual straight one in that it forms a closed magnetic circuit to which tension can be easily applied. The magnetic measurements at low magnetising forces are made by means of the Kelsall permeameter which obviates the necessity of winding a large number of turns of wire around the specimen. The magnetic measurements at high magnetising forces are made in the customary manner with a ballistic galvanometer. The method is illustrated by tests on permivar specimens.

AUTHORS.

***497. New Oscillograph.** E. S. Shire. *Journ. Sci. Instruments*, 11. pp. 379-384, Dec., 1934.—This paper describes a new type of oscillograph in which the moving part consists of a very light single turn coil suspended without torsional control in a constant magnetic field. No leads are attached to the coil, but energy is supplied to it by making it the secondary winding of a transformer, the primary of which carries the current to be recorded. The instrument is rapid, dead beat and of high sensitivity.

AUTHOR.

See also Abstracts 39, 97, 110, 112, 230, 365, 441.

MEDICAL RADIOLOGY AND ELECTROLOGY.

498. Definition of Short-Wave Therapy. Delherm and Fischgold. *J. de Radiologie et d'Électrologie*. 18. pp. 580-582, Nov., 1934.—Of recent years therapeutic application of h.f. oscillations has been developed, notably in Germany by Schliephake and others. The German researchers tend to distinguish such radiation, applied to the patient by condensive action, from the earlier method in which h.f. energy was directly applied to the patient by electrodes in actual contact (d'Arsonvalisation). The present paper is a contentious one, in which the authors assert the term d'Arsonvalisation is also applicable to this more recent short wave oscillation application, and, in support of this, mention experiments carried out by d'Arsonval as long ago as 1892, when wavelengths as low as those in use at present, or even lower, were used by this investigator.

B. J. L.

***499. X-Ray Kymography of the Heart.** P. Stumpf. *Brit. J. of Radiology*, 7. pp. 707-727, Dec., 1934.—X-ray kinematography is not an ideal method of recording body movements accurately, because the evaluation depends on seeing the movement when the film is being shown, the comparison of the individual pictures being extremely difficult. No really continuous record of the movement is obtained. Kymography is the name given to the process in which the X-ray film is moved a short distance behind a slit, or *vice versa*, during the exposure. An oscillatory motion, such as that of the heart margin at right angles to the motion of the film is then recorded as a wave-form. The single slit method of kymography restricts the observations to the movements of a single marginal point of the object studied. In the present work the film is divided into a number of strips by slits 0.4 mm. wide and 12 mm. apart; the film is moved behind the grid a distance equal to the slit separation. Parts which do not move, for instance the ribs, with this arrangement show as straight lines in the direction of movement of the film, but the marginal contours of the heart are recorded as waves, since the movement

of the margin is a lateral thrust. Simultaneously with the marginal displacement, there is a change in the density of the heart shadow corresponding to systole (better illuminated) and diastole (less illuminated), in the form of transverse bands. If the grid is moved instead of the film, the result is more like a normal radiograph. The parts which, during the exposure, do not move are shown exactly as in an instantaneous radiograph, while the moving parts show characteristic movement waves. If the kymograph is observed through a grid moving with the same speed as the original film, the heart or other movements are reproduced, and the phenomena can be studied at leisure. More accurate observations can be made by obtaining a photometric curve of the marginal wave shadows in each strip of the radiograph, the densities being plotted against a time scale, depending on the original exposure. The resulting curves can then be compared with electrocardiograph records for diagnosis purposes. A number of typical kymographs together with photometric curves are given for cases of normal and abnormal hearts. J. E. R.

*** 500. X-Ray Kymography of the Heart. I. S. Hirsch.** *Brit. J. of Radiology*, 7, pp. 728-754, Dec., 1934.—A detailed analysis is made of the use and possibilities of the X-ray kymographic method in the study of heart movements. It is important that the grid spacings should be as small as possible, because points which lie only a relatively short distance apart may exhibit different movements. The speed of movement of the film must be such as to delineate at least one complete detailed wave corresponding to a cardiac cycle with a pulse of 72. Sharpness of detail is obtained by using narrow slits, but as this necessitates higher radiation intensities, it is limited by the tube output. In the work described the slit width was 0.4 mm., the film being moved 12 mm. in an exposure of 1 second, with a tube distance of 100 cm. It is important to note that only movements which are parallel to the slits will be recorded accurately from the point of view of amplitude. A large number of kymographs are given and comparisons made with electrocardiograph records under various conditions. J. E. R.

501. Problem of Quanta in Radiobiology (Biological Aspects.) A. Lacassagne. *J. de Radiologie et d'Électrologie*, 18, pp. 553-560, Nov., 1934.—An historic review is given of theories proposed since 1924, upon the action of radiation on living tissue. Experiments due to the present author are described, in which determined doses of monochromatic radiation were directed upon cellular tissue, in such a manner that the intensity upon the separated cells was the same and so that the actual cells could be later microscopically examined at intervals. Such cells (yeasts) were found to undergo various changes, namely: immediate death, loss of mobility, loss of reproductive powers, abnormalities of cellular division, the production of biological mutations. The view is formed that the effect of radiation upon living tissue, can be explained upon a quantum basis, and that the term "lethal dose" has no precise significance, as the effects are due to chance, *i.e.*, whether particular cells receive the necessary quanta for destruction, under the particular conditions existent. Finally, therapeutic aspects are briefly commented upon, to the effect that, by this quantum theory, the "maximum dosage" application of radiation is most advantageous in the radiation treatment of cancer. B. J. L.

502. Dosimetry in Radium Therapy. G. Gueben and P. Dumont. *J. de Radiologie et d'Électrologie*, 18, pp. 568-574, Nov., 1934.—The effect of radiation in therapy, is dependent upon external factors relating to the
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emission of radiation from its source, *i.e.*, X-ray tube, radium container, etc., and factors relating to the tissue which receives the radiation. In X-ray therapy these factors can be expressed in R units, and, in radium therapy, by milligram-hour, or millicuries. In radium therapy the considerations relating to X-ray therapy are applicable to telecurie therapy, where the source of radiation is distant, but, in the other method of application, namely insertion of tubes or needles containing radium salts, into the actual tissues, other considerations arise. Methods previously proposed to measure dosage are discussed, such as control by biological tissue, photographic and photometric methods, and, particularly, methods dependent upon purely physico-mathematical calculations and ionometric measurement. Isodose curves, directly determined by the author, are then illustrated for various positions of the radium container, in respect to the irradiated subject, it being mentioned that, to obtain the three series of curves shown, manipulation of the container was necessary. Photographs are shown of actual needles used in practice obtained by self-registration, such photographs showing definite variation of the salt, in respect to its general position within the containing tube. As a result the author shows that, as there must necessarily be considerable manipulation and movement of the radium tubes, or needles in practical work (for example, in treatment of cancer of the mouth, the tube has to be repeatedly withdrawn for the purpose of feeding the patient) then, as the position of the radium salt within the tube must necessarily vary from time to time, methods of dosage based upon mathematical, or ionometric considerations, are open to error, failing a solution of this relative movement of the salt, by variations of construction of such tubes, or needles.

B. J. L.

503. Distribution of X-Rays Within the Human Body. Edith H. Quimby, M. M. Copeland and R. C. Woods. *Am. J. of Roentgenology and Radium Therapy*, 32, pp. 534-551, Oct., 1934.—The effect of radiation at any region within the body is dependent upon the radiation reaching the region. In order to measure this, indirect means have been devised such as the water phantom, and these methods are reviewed, as applied to water and other media. Such media cannot exactly represent actual conditions in the human body and similar experiments carried out upon the cadaver are discussed. The present authors have carried out such cadaver measurements in more detail than previously and the data obtained are discussed in relation to tables and graphs. The instrument used was a small ionisation chamber, in conjunction with the vacuum tube instrument of Failla, measurements being made for 200 kV and 700 kV X-rays and γ -rays. At 200 kV, back scattering was found to be less for the cadaver than for water, particularly in respect to the chest and jaw, agreement being given with measurements upon the living subject. In general, at a few centimetres depth of the cadaver, the readings are greater for the cadaver than for water, with differences for the chest and jaw and close agreement for the pelvis and vagina. For positions not directly in the axis of the radiation beam, the values are found to have close agreement with those of isodose charts obtained with the water phantom. Generally, it is found that measurements made with the water phantom approximate closely to actual values. [See also Abstract 2638 (1933).] B. J. L.

504. Medical Physics. W. Friedrich and H. Schreiber. *Die Physik*, 2. 4. pp. 167-176, 1934.—Summarises the main branches of physics as applied to medicine. The subjects discussed include X-rays—their
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production, measurement and biological action—the chief properties of radium, the production, use and measurement of ultra-violet light, diathermy and short wave therapy and some mention of kathode rays. A Bibliography is appended. G. E. B.

OSCILLATIONS.

505. Electronic Theory and the Magnetron Oscillator. W. E. Benham. *Phys. Soc., Proc.* 47. pp. 1–53, Jan. 1, 1935.—The present paper extends previous analysis [see Abstract 2417 (1931)] to cover any degree of space-charge limitation. In addition to terms involving initial velocities and accelerations of electrons, the effect of a magnetic field of constant value has been included. The potential-distribution is shown to be but slightly influenced by the magnetic field under steady-state conditions. It is shown that Langmuir's results for this case still apply fairly accurately for potential-minimum calculations in the presence of a magnetic field. Particular attention is given to the value of the electric field at the cathode and to the average initial velocity of those electrons which reach the potential-minimum and thus constitute the anode current. The prolongation of electron transit time by the magnetic field is fully discussed. The electron-velocity is composed of a forward component parallel to the electric field and a drift component at right angles to both electric and magnetic fields. The forward velocity may be oscillatory in character but the drift velocity is unaffected by alternating fields. The general solution for the forward velocity contains two arbitrary functions the correct choice of which is fully discussed. The inclusion of a magnetic field is definitely of assistance in establishing that the choice of the arbitrary functions is governed mainly by the necessity for avoiding infinite values, rather than by boundary conditions of the usual type. This anomalous state of affairs arises from the non-linearity of the original equations, which involves the introduction at an early stage of the arbitrarily assigned boundary values of the steady-state components of velocity and acceleration as well as those of the d.c. and a.c. Formulæ are given for the components normal and parallel to the plates of the electron-velocity averaged over all electrons. AUTHOR.

See also Abstracts 30, 411, 434, 497.

PHOTOELECTRICITY.

***506. Temperature Variation of Photoelectric Effect.** R. Suhrmann and A. Schallamach. *Zeits. f. Physik*, 91. 11–12. pp. 775–791, Oct. 23, 1934.—Experiments were made at room-temperature, 83° K. and 20° K., using a specially constructed photo-electric cell which could be completely immersed in a liquid air or hydrogen bath. Ag overlaid with a thin film of K, Be and Bi were experimented with as kathodes. Referring to the formula $J = MT^2 e^{-\phi/kT}$ for the total photoelectric emission due to illumination by a black-body source, the work-function ϕ was found to be independent of temperature, while the constant M decreased with decrease of temperature. The variation with temperature of the spectral sensitivity curves of Be and Bi satisfied the Fowler theory. The decrease of sensitivity with cooling in the neighbourhood of the threshold agrees with Fowler's theory, but at increasing distances from the threshold an

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increasing divergence appears. This is attributed to the tighter binding of the electrons to the metal lattice. Effects due to this also appear in the Ag-K kathode. D. H. F.

507. Gas Content and Selective Photoelectric Effect of Potassium. F. Klauer. *Ann. d. Physik*, 20. 8. pp. 909-918, Sept., 1934.—Occluded gas is removed from potassium by repeated distillation in a vacuum and the effect on the photoelectric sensitivity is observed. It is found that freshly distilled pure potassium has a very small sensitivity, complete removal of gas bringing down the value to between 5×10^{-5} and 10^{-4} coulomb per cal. of incident energy in the neighbourhood of the selective maximum (4400 Å). There is a slight increase of sensitivity on standing, due probably to the taking up of gas from the walls of the container. Introduction of very dry H_2 up to pressures of several tenths of a millimetre has no appreciable effect on the sensitivity, but sensitisation by a glow discharge in hydrogen produces a very large increase (160 times at the selective maximum). It is concluded that the selective photoelectric effect of the alkali metals is due to occluded hydrogen and is not a property of the metals themselves. L. A. W.

508. Crystal Photoelectric Effect. G. Mönch and R. Stühler. *Zeits. f. Physik*, 91. 3-4. pp. 253-263, Oct. 2, 1934.—Experiments were carried out on artificial Cu_2O crystals, treated in various ways, and in some of which impurities had been deliberately introduced to imitate the natural crystal; but in no case was the crystal photoelectric effect, as exhibited by the natural crystal, produced. The equation $P = kT/\epsilon \log \sigma_b/\sigma_u$ (σ_b and σ_u being the conductivities under illumination and in the dark respectively) was found to hold for the photo-potential produced in a natural cuprite crystal. Assuming the equation to hold for the artificial sample, P is calculated to fall below the limits of observation. But even at low temperatures, where the effect should be observable, no potential could be detected. The diminution with time of the crystal photoelectric effect was found to be partly, but not entirely, due to heating of the crystal by the light falling on it. [See following Abstract.] D. H. F.

509. Theory of Crystal Photoelectric Effect. G. Mönch. *Zeits. f. Physik*, 91. 3-4. pp. 264-271, Oct. 2, 1934.—The applications to the crystal photoelectric effect of the classical electron theory and of the Fermi statistics are compared. Comparisons with experiment are made and it is shown that Frenkel's formula $\Theta = \frac{k}{\epsilon} \frac{u_- - u_+}{u_- + u_+} T \log \frac{n_b}{n_u}$ deduced on the latter basis, is consistent both with the temperature variation of the effect, and with the fact that artificial Cu_2O crystals do not show the effect. [See preceding Abstract.] D. H. F.

510. Direction of Polarisation and Selectivity in the External Photoelectric Effect of Metals. F. Hlučka. *Zeits. f. Physik*, 92. 5-6. pp. 359-366, Nov. 26, 1934.—The selective photoelectric maxima for the metals Ag, Au, Pt, Ni, Cu, Zn for both directions of polarisation of the light were determined. The photoelectric current as function of the angle of incidence for both directions of the polarisation was measured and approximately calculated. The new proposition valid for all the metals investigated can be stated, that to each optical characteristic vibration two photoelectric maxima lying near each other correspond, of which one belongs to the parallel or to the normal component of the light vector. Thus the selective maxima in the external photoelectric effect of all the

metals examined are conditioned not only by the normal component relative to the cathode surface (as was hitherto assumed from observations on the alkalis) but also by the parallel component, so that the two maxima corresponding to a component appear somewhat shifted with regard to each other. The absence of this effect for the parallel component of the light vector in the alkalis is traced back to the dependence of the optical data on the direction of polarisation existing in that case. J. J. S.

511. Photolysis of Water and Action of Light on Electrodes.

R. Audubert. *J. de Physique et le Radium*, 5. pp. 486-496, Sept., 1934.—A connected account of work already published in support of the author's view that photolysis of water plays an essential part in photovoltaic phenomena, with a discussion of the theory and mechanism thereof. [See Abstracts 4247 (1933) and 3066 (1934).] C. A. S.

***512. Current Generated by Rectifier Photo-Cells.** **H. H. Poole and W. R. G. Atkins.** *Roy. Dublin Soc., Proc.* 21. pp. 133-139, Nov., 1934.—A description is given of a modified form of the circuit described by Campbell and Freeth for the measurement of the current generated by rectifier photo-cells [see Abstract 2233 (1934)]. The modification consists in the deduction of the current from the setting of the potentiometer and the resistance in circuit, instead of its direct measurement. This enables accurate measurements to be made of a range of illuminations from a small fraction of a metre candle up to full sunlight while preserving all the advantages of a zero-resistance measuring instrument. It is especially suitable for work at sea, for which purpose the null-point galvanometer is replaced by an interrupter, amplifier, telephone combination, thus rendering the apparatus suitable for use in a small vessel. AUTHORS.

See also Abstracts 355, 437.

PIEZOELECTRICITY.

513. Liberation of Electricity by Torsion in Quartz. **E. P. Tawil.** *Comptes Rendus*, 199. pp. 1025-1026, Nov. 12, 1934.—A right circular cylinder of quartz having its generator parallel to the principal axis liberates electricity when subjected to torsion about its axis [see Abstract 1615 (1929)]. Charges of opposite sign appear on the curved surface and on the end faces. The charges appearing on the end faces have their origin in the axial region, for with hollow cylinders, which are much more suitable for studying the effect, charges of opposite sign appear on the inner and outer surfaces. When the torsion is in the same sense as the optical rotation, positive electricity is liberated on the outer surface, and *vice versa*. Measurements on cylinders of various shapes show that the quantity liberated is $0.12 \text{ CL/A c.g.s. e.s.u.}$, in which C is the couple in kg-cm., L the length of the cylinder, and A the area of its cross-section. [See following Abstract.] P. V.

514. Electrification by Torsion in Quartz Crystals. **Ny Tsi-Zé and Tsien Ling-Chao.** *Comptes Rendus*, 199. pp. 1101-1102, Nov. 19, 1934.—The quantity of electricity produced by the action of a couple of moment L on a hollow cylinder of quartz, external radius d_o , internal d_i , length l is $klL/d_o(d_o-d_i)$. This expression is almost identical with that deduced by Tawil [see preceding Abstract.], $klL/\pi(d_o^2-d_i^2)$ in the same notation. [See Abstract 3434 (1934).] C. A. S.

515. New Diffraction Effect with Oscillating Crystals. C. Schaefer and L. Bergmann. *Naturwiss.* 22. pp. 685-690, Oct. 12, 1934.

—An account has previously been given [see Abstract 3666 (1934)] of a method of obtaining Laue diagrams in liquids, using three piezoelectric crystals. The present paper describes the production of Laue diagrams in glass blocks, and diffraction figures for oscillating crystals of quartz and calcspar. Two or three quartz plates, as nearly identical as possible, were cemented on the faces of the glass block under investigation, the dimensions of the block being chosen so that one of the elastic oscillation harmonics of the glass-quartz system coincided with a harmonic of the attached quartz plate. A vigorous oscillation of the glass was thus obtained when the quartz plates were connected to a valve oscillator of suitable frequency. Optical means were employed to exhibit the space lattice diagram due to the oscillations in the various directions. Similar diagrams were obtained with prisms of quartz cut with the faces perpendicular to the three electric axes and excited by suitable electrodes supplied by a h.f. oscillator. Non-piezoelectric crystals were tested, using the method employed with the glass blocks. Reproductions are given of typical figures obtained with (a) glass blocks, (b) oscillating quartz crystals, and (c) calcspar.

A. W.

516. Modes of Vibration of Piezoelectric Quartz Plates. S. Nishikawa, Y. Sakisaka and I. Sumoto. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers No. 526.* pp. 20-30, Oct., 1934. *In English.*

—Quartz plates are cut in four ways, namely, parallel to the $(2\bar{1}10)$ $(10\bar{1}0)$, $(10\bar{1}1)$ and $(\bar{1}011)$ planes, and their modes of vibration are studied by observing the effects produced on Laue spots.

J. T.

517. Vibrations of a Piezoelectric Oscillator. E. Hiedemann and N. Seifen. *Zeits. f. Physik*, 91. 5-6. pp. 413-417, Oct. 5, 1934.—

The vibrations of a quartz crystal immersed in xylol are shown to be strongly damped by the energy radiated into the liquid. The resonances of the harmonics are, in consequence, very broad. This effect may be demonstrated to an audience by a method based on the fact that a liquid traversed by ultrasonic waves can act as an optical grating.

J. E. R. C.

518. Temperature Coefficients of Piezoelectric Quartz Plates and Rods. R. Bechmann. *Hochfrequenztechn. u. Elektroakustik*, 44. pp. 145-160, Nov., 1934.—

Following a discussion of the elastic properties of quartz crystals and the natural oscillation frequencies of quartz slices and rods an account is given of an experimental investigation of the properties of slices cut in a special manner. The slices used were rectangular and in the cut designated $X\delta$, two edges of the slice were parallel to the y -axis, while the normal to the slice made an angle δ with the z -axis. In the cut designated $Y\delta$ two edges of the slice were parallel to the x -axis, while the normal to the slice made an angle δ with the z -axis. The x -axis is one of the electric axes, the z -axis is the optic axis and the y -axis at right angles to the other two. In the case of slices of the $Y\delta$ cut it was found that for values of δ of 41.5° and 125° the temperature coefficient (a) was less than 1 part in 10^7 per 1° C. For $\delta = 90^\circ$ the value of a was as high as $+76$ parts in 10^6 per 1° C. and for $\delta = 145^\circ$ a was -68 parts in 10^6 per 1° C. With $X\delta$ plates three frequencies were in general found, the frequencies being in good agreement with those calculated from the elastic constants of quartz. Experiments with quartz rods showed that for these also temperature coefficients approximating to zero may be obtained by

suitable orientation with respect to the x, y, z axes, providing the dimensions of the rods are suitably proportioned. In order to explain the observed effects a three-dimensional model is described whose contours exhibit the temperature coefficient of elasticity for different sections. Further investigations on the effect of the relative dimensions (form-factor) on the temperature coefficient of slices and rods are in progress and the results will be communicated in a subsequent paper. A. W.

See also Abstracts 40, 51, 242, 398.

THERMIONICS.

519. Theory of Surface Ionisation on Glowing Metals. A. Anselm. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 3. 5. pp. 329-334, 1934. In German. *Phys. Zeits. d. Sowjetunion*, 6. 5. pp. 505-512, 1934. In German.—If ν_p and ν_a are the numbers of positive ions and neutral atoms of alkali, liberated per sec. per cm.² from a glowing metal surface, when bombarded by the alkali atoms, the following formula is obtained by applying Sommerfeld's theory of metals: $\nu_p/\nu_a = e\epsilon(\phi - V_i)/KT$, where ϵ is the electron charge, ϕ the work of liberation, V_i the ionisation potential of the alkali metal, K Boltzmann's constant and T the absolute temperature. Modifying a formula obtained by thermodynamic theory to agree with experimental results, the above formula is again produced. A recent experiment by Copley and Phipps supports the equation. H. M. B.

520. Emission of Electrons from Cold Metal Surfaces. C. C. Chambers. *Frank. Inst., J.* 218. pp. 463-484, Oct., 1934.—The results of del Rosario on cold emission [see Abstracts 1347 and 2604 (1928)] are shown to result from the fact that, through the attainment of specially good vacuum conditions and freedom from contamination, the cold electron current from the wire was suppressed up to field strengths greater than those at which measurable current was obtained in the work of previous observers. It was in fact suppressed beyond the point at which discharge started from points on the welding of the support. The results of del Rosario are thus probably characteristic of conditions other than those pertaining to the wire, a conclusion which accounts for his current voltage curves. The formula of Fowler and Nordheim is found to apply in the measurable regions in form directly and in magnitude only if irregularities of the surface are such as to raise the field at the surface to a sufficiently high value. Breakdowns after intense heat treatment are studied and found to be caused by immeasurably small currents of electrons knocking ions from the anode. The erratic original curves obtained by previous investigators are found to be caused by successive breakdowns similar to those found after intense heating. AUTHORS.

See also Abstracts 455, 466, 481.

THERMOELECTRICITY.

521. Peltier and Thomson Effects and Entropy. A. Liénard. *Comptes Rendus*, 199. pp. 838-840, Oct. 29, 1934.—It is shown that the idea of the entropy of a portion of a conductor of volume U , can be maintained in thermoelectricity if the usual equation $dQ/T = dS$, is replaced by $dS = \int_U dQ/T + \int_{surf U} H \delta q$, where H is a function introduced on account of the Peltier and Thomson effects and δq is the quantity of electricity traversing an element of the surface of U . R. W. P.

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